

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re CONTINUATION APPLICATION

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Examiner: Unassigned

Application No.: Cont. of 08/993,721

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For: HIGHLY BANDWIDTH EFFICIENT COMMUNICATIONS

**PRELIMINARY AMENDMENT**

Commissioner of Patents  
Washington, D.C. 20231

Sir:

Prior to official Office Action, please amend the above-identified continuation application as follows:

**IN THE DRAWINGS**

Please REPLACE the drawings filed with this application with the attached SUBSTITUTE Drawings. No new matter is added by replacing the drawings. The corrected drawings are submitted to render the drawing labeling consistent with the amendments to the specification set forth below.

**IN THE SPECIFICATION**

Please REPLACE the following paragraphs in the specification as follows:

**Page 11, line 32 through page 16, line 16, the Brief Description of the Drawings**

**Section:**

In the drawings:

FIGURE 1A is a tutorial diagram illustrating an example of pure spectral diversity, showing how a receiver distinguishes two sets of discrete multitone signals from two transmitters that are placed close to one another, in accordance with the invention.

FIGURE 1B is a tutorial diagram illustrating an example of pure spatial diversity, showing how a receiver distinguishes two discrete monotone signals from two transmitters that are placed far from one another, in accordance with the invention.

FIGURE 1C is a tutorial diagram illustrating an example of both spectral and spatial diversity, showing how a receiver distinguishes two discrete multitone signals from two transmitters that are placed far from one another, in accordance with the invention.

FIGURE 1D is a high-level schematic representation of an implementation of the invention in a fixed wireless communication system.

FIGURE 2 is a simplified representation of multitone transmission.

FIGURE 3 is a simplified representation of the use of a discrete multitone stacked carrier signal format.

FIGURE 4 is a simplified representation of the matrix formalism used in an implementation of the invention.

FIGURE 5 is a simplified representation of the matrix formalism, used in an implementation of the invention, that includes the effects of channel response.

FIGURE 6 is a simplified representation of DMT-SC using an exemplary higher order QAM modulation format.

FIGURE 7 is a timing diagram that illustrates the general time division duplex signal and protocol used in an embodiment of the invention.

FIGURE 8 is a signal processing flow diagram that depicts the main signal processing steps used in an embodiment of the invention to provide for high bandwidth efficiency.

FIGURE 9 is a signal processing flow diagram that illustrates a method used to spread the encoded carrier signal.

FIGURE 10 is a three-dimensional plot of the signal to interference plus noise ratio versus code weights and spatial weights applied to the transmitted and received signals.

FIGURE 11 is a perspective cut away view showing an embodiment of a base station antenna.

FIGURE 12 is a perspective cut away view showing a second embodiment of a base station antenna.

FIGURE 13 graphically depicts the null steering aspect of the present invention.

FIGURE 14 is a schematic representation of an inverse frequency channelized spreader implementation.

FIGURE 15 is a schematic representation of a frequency channelized despreader implementation.

FIGURE 16 is a plot of antenna gain versus angular direction.

FIGURE 17 is a highly simplified block diagram that illustrates one particular application of the highly bandwidth-efficient communications network of the present invention.

FIGURE 18 is a list of the possible operational frequency bands of a specific embodiment of the invention.

FIGURE 19 shows the RF Band/Sub-band organization of the airlink of a specific embodiment of the invention.

FIGURE 20 shows the tones within each sub-band of a specific embodiment of the invention

FIGURE 21 shows the traffic partitions in a specific embodiment of the invention

FIGURE 22 shows the tone mapping to the  $i$ th traffic partition

FIGURE 23 shows the overhead tone Mapping to Channels for the  $i$ th Sub-band Pair

FIGURE 24 shows the Division of Tone Space to Traffic and Overhead Tones

FIGURE 25 shows the time Division Duplex format for Base and Remote Unit Transmissions

FIGURE 26 shows Details of the Forward and Reverse Channel Time Parameters

FIGURE 27 shows the TDD Parameter Values

FIGURE 28 shows the Physical Layer Framing Structure

FIGURE 29 shows the Phase A Sub-band Pair Assignment Within a Spatial cell

FIGURE 30 shows the Phase-A Sub-band Pair Assignment Across Spatial cells

FIGURE 31 is a Functional Block Diagram for the Upper Physical Layer of Base

Transmitter for High Capacity Mode

FIGURE 32 is a Data Transformation Diagram for the High Capacity Forward Channel

Transmissions

FIGURE 33 is a Functional Block Diagram for the Upper Physical Layer of Base

Transmitter for Medium Capacity Mode

FIGURE 34 is a Data Transformation Diagram for the Medium Capacity Forward Channel Transmissions

FIGURE 35 is a Functional Block Diagram for the Upper Physical Layer of Base Transmitter for Low Capacity Mode

FIGURE 36 is a Data Transformation Diagram for the Low Capacity Forward Channel Transmissions

FIGURE 37 is a representation of the Triple DES Encryption Algorithm

FIGURE 38 depicts a Feed Forward Shift Register Implementation of Rate 3/4, 16PSK Trellis Encoder for High Capacity Mode

FIGURE 39 depicts a Feed Forward Shift Register Implementation of Rate 3/4, 16QAM Trellis Encoder for High Capacity Mode

FIGURE 40 shows the Signal Mappings for Rate  $3/4$ , 16QAM and 16PSK Trellis

Encoding Schemes Employed in High Capacity Mode

FIGURE 41 shows the Signal Mappings for Rate  $3/4$ , Pragmatic 16 QAM and 16 PSK

Trellis Encoding Schemes Employed in High Capacity Mode

FIGURE 42 depicts a Feed Forward Shift Register Implementation of Rate  $2/3$ , 8PSK

Trellis Encoder for Medium Capacity Mode

FIGURE 43 depicts a Feed Forward Shift Register Implementation of Rate  $2/3$  8QAM

Trellis Encoder for Medium Capacity Mode

FIGURE 44 shows the Signal Mappings for Rate  $2/3$ , 8QAM and 8PSK Trellis Encoding

Schemes Employed in Medium Capacity Mode

FIGURE 45 shows the Signal Mappings for Rate  $2/3$ , 8QAM and 8PSK Trellis Encoding

Schemes Employed in Medium Capacity Mode

FIGURE 46 depicts a Feed Forward Shift Register Implementation of Rate  $1/2$

Convolutional Encoder for Low Capacity Mode

FIGURE 47 shows the Signal Mapping for Rate  $1/2$ , QPSK Pragmatic Trellis Encoding

Scheme Employed in Low Capacity Mode

FIGURE 48 shows the Gray-Coded Mapping for Rate  $1/2$ , QPSK Pragmatic Trellis

Encoding Scheme Employed in Low Capacity Mode

FIGURE 49 shows the Base Mapping of Elements of Received Weight Vectors to

Antenna Elements and Tones

FIGURE 50 is a Block Diagram Representation of CLC Physical Layer Format

FIGURE 51 shows the QPSK Signal Mapping for the CLC Channel

FIGURE 52 is a representation of the CLC Interleaving Rule

FIGURE 53 shows the Tone Mapping of  $(4 \times 4)$  Interleaved Matrix Elements

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FIGURE 54 is a Block Diagram Representation of BRC Physical Layer Format

FIGURE 55 shows the Tone Mapping of the (4 x 4) Interleaved Matrix Elements

FIGURE 56 is a representation of a Broadcast Channel Beam Sweep

FIGURE 57 is a Functional Block Diagram of the Upper Physical Layer of Remote Unit Transmitter for High Capacity Mode

FIGURE 58 is a Data Transformation Diagram for the High Capacity Reverse Channel Transmissions

FIGURE 59 is a Functional Block Diagram for the Upper Physical Layer of Remote Unit Transmitter for Medium Capacity Mode

FIGURE 60 is a Data Transformation Diagram for the Medium Capacity Reverse Channel Transmissions

FIGURE 61 is a Functional Block Diagram for the Upper Physical Layer of Remote Unit Transmitter for Low Capacity Mode

FIGURE 62 is a Data Transformation Diagram for the Low Capacity Reverse Channel Transmissions

FIGURE 63 shows the Remote Unit Tone Mapping of Received Weight Vector Elements

FIGURE 64 is a Block Diagram Representation of the CAC Physical Layer Format

FIGURE 65 shows the BPSK Signal Mapping for the CAC Channel

FIGURE 66 depicts the CAC Interleaving Rule

FIGURE 67 shows the Tone Mapping of the (8 x 2) Interleaved Matrix Elements

FIGURE 68 is a Functional Block Diagram for the Lower Physical Layer of Base Transmitter

FIGURE 69 shows Tone Mapping into DFT Bins

FIGURE 70 shows Tone Mapping into DFT Bins

FIGURE 71 is a block diagram that illustrates the main structural and functional elements of the bandwidth on demand communications network of the present invention.

FIGURE 72 is a functional block diagram that illustrates the main functional elements of the high bandwidth remote access station.

FIGURE 73 is a functional block diagram that shows the main functional components of the high bandwidth base station.

FIGURE 74 is an overall system schematic block diagram that shows the main structural and functional elements of one implementation of the highly bandwidth-efficient communication system in greater detail.

FIGURE 75A depict the digital architecture within an exemplary remote access terminal.

FIGURE 75B depict the digital architecture within an exemplary remote access terminal.

FIGURE 76 is a software block diagram that indicates the general processing steps performed by each of the digital signal processing chips within the digital signal processing architecture of FIGURES 75A and 75B.

FIGURES 77A-77D are block diagrams that show in detail the digital architecture of the LPA cards of FIGURES 75A and 75B.

FIGURES 78A-78C are block diagrams that detail the digital architecture used to support the main digital signal processing chips on the interface card of FIGURES 75A and 75B.

FIGURES 79A-79D are a schematic block diagram that depicts the overall digital signal processing architectural layout within an exemplary base station of the present invention.

FIGURE 80 is a schematic block diagram showing a dual band radio frequency transceiver that may advantageously be used in the high bandwidth remote access station shown in FIGURE 74.

FIGURE 80A is a schematic block diagram showing the main internal functional elements of the synchronization circuitry shown in FIGURE 80.

FIGURE 81 is a schematic block diagram depicting a dual band radio frequency transceiver that may advantageously be implemented within the high bandwidth base station shown in FIGURE 74.

FIGURE 81A is a simplified schematic block diagram showing the main internal components of the frequency reference circuit shown in FIGURE 81.

FIGURE 82 is a schematic block diagram of a dual band radio frequency transmitter of a type that may advantageously be implemented within a base station constructed in accordance with the present invention.

FIGURE 83 depicts the bandwidth allocation method performed by the bandwidth demand controller of FIGURE 74.

FIGURE 84A and FIGURE 84B show an alternate embodiment of the invention, where the spectral processing and the spatial processing are separated.

FIGURE 85 is an illustrative flowchart of an embodiment of the adaptive solution of spectral and spatial weights.

FIGURE 86 is a block diagram of a plurality of remote stations coupled to a base station over a wireless link using discrete multitone spread spectrum communication and incorporating the principles of the present invention.

FIGURE 87 is a block diagram of a base station included in FIGURE 86.

FIGURE 88 is a flow diagram which implements the operation of the invention of FIGURES 86 and 87.

FIGURE 89 is an architectural diagram of the PWAN system, including remote stations transmitting to a base station.

FIGURE 90 is an architectural diagram of the remote station X as a sender.

FIGURE 91 is an architectural diagram of the base station Z as a receiver.

FIGURE 92 is a more detailed architectural diagram of the priority message processor 204 at the sending station.

FIGURE 93 is a flow diagram showing the remote station as the sender and the base station as the receiver.

FIGURE 94 is a more detailed architectural diagram of the priority message processor 320 at the receiving station.

FIGURE 95 is an architectural diagram of the PWAN system, showing the base station polling a remote station over the common link channel.

FIGURE 96 is an architectural diagram of the PWAN system, showing the remote station transmitting a functional quality and maintenance message to the base station over the common access channel.

FIGURE 97 is an architectural diagram of the remote station X as a sender of functional quality and maintenance data.

FIGURE 98 is an architectural diagram of the base station Z as a receiver of functional quality and maintenance data.

FIGURE 99 is a flow diagram of the sequence of operational steps for the invention.

FIGURE 100 is an architectural diagram of the personal wireless access network (PWAN), showing the base station Z transmitting forward pilot tones with a prearranged initial forward signal power level, to the remote station X and to the remote station Y.

FIGURE 101 is an architectural diagram of the personal wireless access network (PWAN) of FIGURE 100, showing the remote station X transmitting reverse pilot tones with a prearranged initial reverse signal power level, to the base station Z.

FIGURE 102 is a network diagram of two cells engaging in a first stage of retrodirective coupling, where the base station B1 in cell 1 detects the presence of interfering signals from the remote station R2 in the neighboring cell 2. Base station B1 adjusts its transmissions in the direction of remote station R2 to diminish their signal strength.

FIGURE 103 is a network diagram of the two cells of FIGURE 102 in a second stage of retrodirective coupling, where the base station B2 in the second cell 2 detects the presence of interfering signals from the remote station R1' in the first cell 1. Base station B2 adjusts its transmissions in the direction of remote station R1' to diminish their signal strength.

FIGURE 104 is a network diagram of the four cells similar to FIGURES 1A and 1B, showing propagation of channel optimization across cell boundaries to optimize the channel characteristics throughout the entire system.

FIGURE 105 is a more detailed block diagram of base station B1 and remote station R1' in cell 1 and remote station R2 in cell 2, where remote station R2 is sending interfering signals to the base station B1.

FIGURE 106 is a detailed block diagram similar to FIGURE 105, showing the base station B1 sending diminished strength signals across the cell boundary, in the direction of the interfering remote station R2.

**Page 96, lines 18 to 29:**

Figure 85A, consisting of Figures 85 A-L and 85 A-R, is a flow diagram of a preferred embodiment, describing the computational steps performed in the base station. In the transmission portion of the base station, traffic symbols are input on line 5 to the smear matrix step 10. Link maintenance pilot signals are input on line 7 to the digital signal processor (DSP) data processing RAM 12. Stored pilot signals are output from the RAM 12 to the link

maintenance pilot (\*LMP) register 14 and are then applied as one input to the smear step 10. The smear matrix 16 is also applied to the smear step 10. The output of the smear matrix 16 is also applied to the smear step 10. The output of the smear step 10 is applied to the gain emphasis step 20. The values from the gain RAM25 are applied to the gain emphasis step 20 to provide output values which are then applied to the beam form spreading step 30. Spreading weights in a spread weight RAM 32 are applied to the beam form spread step. The X vector is output on line 40 from the beam form spread step and is sent to the transmitter for transmission to the remote station.

**Page 97, lines 25 through 36:**

Figure 85B, consisting of Figures 85B-L and 85B-R, shows the processing of the common access channel signals. Two common access signals (CAC) signals from the transmitter are processed. A first signal is processed being received on the input line 102 and is applied to the RMGS auto-correlation step 104, whose output goes to the digital signal matrix step 106 whose output goes to the digital signal processor. The common access channel signal online 102 is also applied to the select ungated packets step 108 and to the select gated packets step 110. The output of the select ungated packets 108 is applied to the subtract even/odd packets step 112. The output of the selected gate packets 110 is applied to the apply code key step 114. The CAC code key step 116 applies it's value to the apply code key step 114. the output of the apply code key step 114. The output of the apply code key step 114 is also applied to the subtract even/odd packets step 112. The output of the subtract even/odd packets step 112 is applied to the RMGS autocorrelation step 118, whose output is also applied to the compute T matrix step 106. The output of the compute T matrix step 106 is then applied to the digital signal processor.

**Page 106, the Brief Description of the Drawings Section:**

Figure 86 is a block diagram of a plurality of remote stations coupled to a base station over a wireless link using discrete multitone spread spectrum communication and incorporating the principles of the present invention.

Figure 87 is a block diagram of a base station included in Figure 86.

Figure 88 is a flow diagram which implements the operation of the invention of Figures 86 and 87.

**Page 106, line 15 through page 107, line 2:**

In Figure 86, a remote station "X" and a remote station "Y" are coupled to a base station "Z" over a wireless link using traffic channels for data traffic, and a common access channel (CAC) and a common link channel (CLC) for control information. Each remote station includes a plurality of subscribers coupled to a transmitter/receiver which uses the discrete multitone spread spectrum protocol for transmissions. Communication between the remote stations and the base station is performed in the manner described in the above cited S. Alamouti et al. and E. Hoole et al. applications.

**Page 109, line 6 through line 14:**

In Figure 87, a base station further includes a spectral and spatial despreading processor 312 which interacts with the spreading and despreading databases in accordance with the S. Alamouti et al. application previously cited. The processor is coupled to a decoder which provides an output to a vector disassembly buffer 316 for generating subscriber data originated in a call. The decoder is also coupled to a subscriber database buffer which contains information related to the subscriber name, number and other standard subscriber information including, for

example, subscriber profiles. The output of the database buffer is provided to a call set up processor 330 or an error processor 322 as will be described in more detail hereinafter. The processors 330 and 322 are connected to the network switch 202.

**Page 109, line 15 through page 110, line 15:**

The operation of Figures 86 and 87 will now be described in conjunction with Figure 88. In step 710, a subscriber coupled to a remote station originates a call which initiates an "off hook" condition at the station. A set up connection request is initiated by the remote station in a step 720. The remote station transmits setup request message; the remote station ID and subscriber line number to the base station using a CAC tone. The base station responds to the set up connection request in step 730 and accesses the database 320 to identify the subscriber and obtain the subscriber profile. Simultaneously, in steps 740 and 743, the base station initiates the establishment of a traffic channel to the remote station and sends the set up request; remote user ID, subscriber line number and subscriber profile to the network switch 202. The network switch initiates the set up in a step 745 and provides dial tone to the subscriber at the remote station. During the process of establishing the traffic channel, the base station performs a test in a step 742 to determine whether a traffic channel has been established between the remote station and the base station. In some instances, the radio propagation characteristics of the channel are such that a link cannot be established. In the event that a link cannot be established, a "no" condition from the test 742 activates the error processor 322 which provides the network switch in a step 744 with a signal to a logic device which signals the network switch to disassemble or "tear down" the call set up in the PSTN, if the base station has sent the set up request message. In response to the logic device signal, the network switch in a step 749 "tears down" the PSTN connections and the process ends. In the instance where the traffic channel is completed, a "yes" condition sends a signal to a logic device whereupon the network switch completes the call in a

step 747, provided the call setup has been initiated and dial tone provided to the subscriber by the network switch.

**Page 117, the Brief Description of the Drawings Section:**

Figure 89 is an architectural diagram of the PWAN system, including remote stations transmitting to a base station.

Figure 90 is an architectural diagram of the remote station X as a sender.

Figure 91 is an architectural diagram of the base station Z as a receiver.

Figure 92 is a more detailed architectural diagram of the priority message processor 204 at the sending station.

Figure 93 is a flow diagram showing the remote station as the sender and the base station as the receiver.

Figure 94 is a more detailed architectural diagram of the priority message processor 320 at the receiving station.

**Page 118, line 1 through line 22:**

Figure 89 is an architectural diagram of the personal wireless access network (PWAN) system described in the referenced Alamouti, Stolarz, et al. patent application. Two users, Alice and Bob, are located at the remote station X and wish to transmit their respective data messages to the base station Z. Station X is positioned to be equidistant from the antenna elements A, B, C, and D of the base station Z. Two other users, Chuck and Dave, are located at the remote station Y and also wish to transmit their respective data messages to the base station Z. Station Y is geographically remote from Station X and is not equidistant from the antenna elements A, B, C, and D of the base station Z. The remote stations X and Y and the base station Z use the form of the CDMA protocol known as discrete multitone spread spectrum ( DMT-SS ) to

provide efficient communications between the base station and the plurality of remote station units. This protocol is designated in Figure B1 as multi-tone CDMA. In this protocol, the user's data signal is modulated by a set of weighted discrete frequencies or tones. The weights are spreading weights that distribute the data signal over many discrete tones covering a broad range of frequencies. The weights are complex numbers with the real component acting to modulate the amplitude of a tone while the complex component of the weight acts to modulate the phase of the same tone. Each tone in the weighted tone set bears the same data signal. Plural users at the transmitting station can use the same tone set to transmit their data, but each of the users sharing the tone set has a different set of spreading weights. The weighted tone set for a particular user is transmitted to the receiving station where it is processed with despreading weights related to the user's spreading weights, to recover the user's data signal. For each of the spatially separated antennas at the receiver, the received multitone signals are transformed from time domain signals to frequency domain signals. Despreading weights are assigned to each frequency component of the signals received by each antenna element. The values of the despreading weights are combined with the received signals to obtain an optimized approximation of individual transmitted signals characterized by a particular multitone set and transmitting location.

**Page 120, line 15 through page 121, line 11:**

The following describes the operation of the remote station X in sending system management messages to the base station Z. The remote station and the base station are part of a wireless discrete multitone spread spectrum communications system. The remote station, which is the sending station in this example, includes a priority message processor 204 shown in Figure 90 and in Figure 92, that selects the order in which system management messages are transmitted over the link control channel (LCC). The order of selection is by the time criticality of the

message. Those messages having a greater time criticality are selected to be transmitted first. The priority message processor 204 in the sending station is programmed by program 400 of Figure 92, to rank call control messages, connect messages, acknowledgement messages for call control, and signaling messages, for example, to have a greater time criticality than system status messages or software downloads have. The burst size transmitted from a sending station is a fixed number of bits long, for example forty-eight bits in length. If the message to be sent is longer than the burst size, then the priority message processor 204 at the sending station uses the priority message buffer 420 in Figure 92, to break the message into segments. In accordance with the invention, a priority interrupt flag "P" of one bit in length is included with each message segment, to identify whether the segment is the first occurring segment in a message. A first segment of a message, with a priority interrupt flag bit  $P = 1$ , will be sent in a first occurring transmit burst time. The remaining segments that are not the first segment of a message, those segments with a priority interrupt flag bit  $P = 0$ , will be sent in a later occurring transmit burst times. This enables the sending station and the receiving station to cooperate in managing the communication of system management messages having differing time criticality.

**Page 122, lines 11 through 22:**

In accordance with the invention, the base station Z of Figure 91 receives the burst with the first spread signal and the second spread signal. The base station adaptively despreads the first spread signal received by using despreading weights in the spectral and spatial despreading processor 312, recovering the data portion. The base station also adaptively despreads the second spread signal received by using despreading weights, recovering the message segment portion and the priority interrupt flag portion. The base station includes a priority message processor 320 shown in Figure 91 and in Figure 94, that receives from the link control channel, the first message segment of the call control message. The priority message processor 320 at the

base station then resets a message segment buffer 322 in the base station and stores the first segment of the call control message in the buffer 322, if the priority interrupt flag "P" has a first value of one. The first value of one for the priority interrupt flag "P" corresponds to a time critical message segment. This operation effectively substitutes the more time critical call control message for the first, status message at the base station Z.

**Page 123, lines 7 through 20:**

In an alternate embodiment of the invention, the base station's priority message processor 320 of Figure 94, selectively reassigns its message processing capacity from low priority messages it is currently transmitting, to more time critical messages that it receives on the link control channel. In accordance with the invention, the base station Z is currently transmitting a transmitted spread signal comprising an outgoing data traffic signal spread over a plurality of discrete traffic frequencies and an outgoing message segment signal spread over a plurality of link control frequencies. This takes place during the transmit interval of a time division duplex session with the remote station X. The outgoing message segment signal from the base station is part of a low priority message, such as a software download to the remote station. During the next receive interval of the time division duplex session, the base station Z receives a spread signal comprising an incoming data traffic signal spread over a plurality of discrete traffic frequencies and an incoming message segment signal spread over a plurality of link control frequencies. The base station adaptively despreads the signals received at the base station by using despreading weights in its spectral and spatial despreading processor 312 of Figure 91. Then the base station's priority message processor 320 of Figure 94, detects a priority interrupt flag value "P" in the message segment signal.

**Page 123, line 21 through page 124 line 19:**

In accordance with the alternate embodiment of the invention, the base station's priority message processor 320 acts to reassign the station's message processing capacity by interrupting the next scheduled transmission of the second outgoing message segment signal. An example where this operation is required is when the remote station X sends a call control message to the base station that requires the base station to quickly respond with a reply message. The priority message processor 320 detects the priority interrupt flag  $P = 1$  in the first segment of the call control message, and in response, resets the message segment buffer 322 in the base station. The priority message processor 320 stores the incoming message segment signal in the message segment buffer 322. The priority message processor 320 of Figure 94, determines that the call control message received from the remote station requires a quick reply. In response to this, the priority message processor 320 at the base station stores the last segment number sent for the low priority outgoing message it has been sending to the remote station. The base station can then transmit its reply message to the remote station. In this manner, quick reply message can be sent in response to request messages. After the reply message has been sent by the base station, the last segment number sent for the low priority outgoing message is retrieved by the priority message processor 320 and transmission is resumed by the base station, starting with the next segment number for the low priority outgoing message. Alternately, the base station concatenates the incoming message segment signal with a previously received message segment, if the priority interrupt flag has a second value of zero. The second value of zero for the priority interrupt flag corresponds to a message segment that is not a first message segment in a message having plural segments. In this manner, the invention manages the exchange of system management messages over the link control channel between a remote station and the base

station so that time critical system management messages are given priority over those that are not time critical.

**Page 124, line 20 through page 125, line 6:**

In Figure 90, Alice and Bob each input data to remote station X. The sender's traffic data is sent to the vector formation buffer 202 and the sender's system management information is sent to the priority message processor 204, shown in greater detail in Figure 92. Data vectors are output from buffer 202 to the trellis encoder 206. The data vectors are in the form of a 48-bit data message segment per transmit burst. The LCC vectors output from the priority message processor 204 to the trellis encoder 206 are in the form of a 48-bit priority message segment per transmit burst, formed by concatenating a 47-bit message segment with the one-bit priority interrupt flag. The trellis encoded data vectors and LCC vectors are then output to the spectral spreading processor 208. The resultant data tones and LCC tones are then output from processor 208 to the transmitter 210 for transmission to the base station.

**Page 125, lines 7 through 13:**

The first four steps in the flow diagram 700 of Figure 93 show the steps at remote station X when it is the sender. The steps in the method of transmission from a remote station to a base station are first for the Remote Station in step 710 to generate a priority message segment in the priority message processor 204 of figure 92 and input it as a vector to the link control channel. Then in step 720, the Remote Station performs trellis encoding of the link control channel vector and the data vectors. Then in Step 730, the Remote Station performs spectral spreading of the trellis encoded link control channel vector and data vectors. Then in Step 740, the Remote Station transmits the link control channel tone and data tones to the base station.

**Page 127, lines 6 through 13:**

Figure 91 is an architectural diagram of the base station Z as a receiver. The data tones and LCC tones are received at the base station antennas A, B, C, and D. The receiver 310 passes the data tones and the LCC tones to the spectral and spatial despreading processor 312. The despread signals are then output from the processor 312 to the trellis decoder 314. The data vectors are then output to the vector disassembly buffer 316. The LCC vectors are output to the priority message processor 320, shown in greater detail in Figure 94. Alice's data and Bob's data are output from the buffer 316 to the public switched telephone network (PSTN). Priority message segments are passed from the priority message processor 320 to the priority message buffer 322. There the segments are concatenated into a full message 325 to be output on line 330.

**Page 127, line 14 through page 128, line 2:**

The last five steps in the flow diagram 700 of Figure 93, show the base station Z as the receiver. In Step 750, the Base Station performs spectral and spatial despreading of the link control channel tone and data tones. Then, in Step 760, the Base Station performs trellis decoding of despread link control channel tone and data tones. Then in Step 770, the Base Station's priority message processor 320 determines if the priority interrupt flag  $P = 1$ . If it does, then priority message processor 320 resets the priority message buffer 322 and loads the newly received message segment in buffer 322. In step 780, alternately, if the Base Station's priority message processor 320 determines that the priority interrupt flag  $P = 0$ , then it concatenates the newly received message segment with the previously received message segment for the same message in buffer 322. Then in Step 790, the priority message buffer 322 combines the plural message segments into a complete message and outputs it on line 330. The completed message

can be processed within the base station or it can be forwarded along with the received data to the public switched telephone network.

**Page 133 to 134, the Brief Description of the Drawings:**

Figure 95 is an architectural diagram of the PWAN system, showing the base station polling a remote station over the common link channel.

Figure 96 is an architectural diagram of the PWAN system, showing the remote station transmitting a functional quality and maintenance message to the base station over the common access channel.

Figure 97 is an architectural diagram of the remote station X as a sender of functional quality and maintenance data.

Figure 98 is an architectural diagram of the base station Z as a receiver of functional quality and maintenance data.

Figure 99 is a flow diagram of the sequence of operational steps for the invention.

**Page 134, line 5 to page 135, line 19:**

Figure 95 is an architectural diagram of the PWAN system, showing the base station polling a remote station over the common link channel. Figure 96 shows the remote station transmitting a functional quality and maintenance message to the base station over the common access channel. These are diagrams of the personal wireless access network (PWAN) system described in the referenced Alamouti, Stolarz, et al. patent applications. Two users, Alice and Bob, are located at the remote station X and wish to transmit their respective data messages to

the base station Z. Station X is positioned to be equidistant from the antenna elements A, B, C, and D of the base station Z. Two other users, Chuck and Dave, are located at the remote station Y and also wish to transmit their respective data messages to the base station Z. Station Y is geographically remote from Station X and is not equidistant from the antenna elements A, B, C, and D of the base station Z. The remote stations X and Y and the base station Z use the form of the CDMA protocol known as discrete multitone spread spectrum ( DMT-SS ) to provide efficient communications between the base station and the plurality of remote station units. This protocol is designated in Figure 95 as multi-tone CDMA. In this protocol, the user's data signal is modulated by a set of weighted discrete frequencies or tones. The weights are spreading weights that distribute the data signal over many discrete tones covering a broad range of frequencies. The weights are complex numbers with the real component acting to modulate the amplitude of a tone while the complex component of the weight acts to modulate the phase of the same tone. Each tone in the weighted tone set bears the same data signal. Plural users at the transmitting station can use the same tone set to transmit their data, but each of the users sharing the tone set has a different set of spreading weights. The weighted tone set for a particular user is transmitted to the receiving station where it is processed with despreading weights related to the user's spreading weights, to recover the user's data signal. For each of the spatially separated antennas at the receiver, the received multitone signals are transformed from time domain signals to frequency domain signals. Despreading weights are assigned to each frequency component of the signals received by each antenna element. The values of the despreading weights are combined with the received signals to obtain an optimized approximation of individual transmitted signals characterized by a particular multitone set and transmitting location.

**Page 137, lines 10 through 20:**

In accordance with the invention, a new method makes the most efficient use of the scarce spectral bandwidth in a wireless discrete multitone spread spectrum communications system. Each remote station in the network collects functional quality and maintenance data for itself. During each data traffic session that a remote station has with the base station, the remote station X of Figure 97 computes the signal-to-interference-and-noise ratio (SINR) as a byproduct of receiving the discrete multitone spread spectrum signals from the base station Z. The remote station stores the SINR data that it accumulates in a SINR history buffer 224. The remote station also computes the path loss of the signals received from the base station and stores the values it accumulates in a path loss history buffer 226. The remote station runs self-test programs on a periodic basis and stores the results in a self-test results buffer 220. And the remote station monitors the status of its backup battery and stores the status in a battery status buffer 222. Other functional quality and maintenance data can also be monitored by the remote station and stored in buffers.

**Page 137, line 21 through page 138, line 11:**

In accordance with the invention, the base station Z periodically transmits a discrete multitone spread spectrum (DMT-SS) signal on the common link channel to each remote station, polling the respective remote station, as shown in Figure 95. The common link channel (CLC) is used by the base to transmit control information to the remote stations. Simultaneously, data traffic from the public switched telephone network (PSTN) arrives at the base station Z and is converted into data traffic DMT-SS tones which are transmitted to the remote stations. In response to the base station's polling signal being received by the remote station X at its input 230, the respective remote station of Figure 97, activates its polling response processor 228 to respond the poll. The polling response processor 228 accesses the self test buffer 220, the

battery status buffer 222, the SINR history buffer 224, and the path loss buffer 226 to assemble a functional quality and maintenance data message. The message is formed into a common access channel vector that is input to the trellis encoder 206 and then to the spectral spreading processor 208 to produce the common access channel tone. The common access channel tone with the functional quality and maintenance data message is then transmitted by transmitter 210 as a DMT-SS signal back to the base station Z on the common access channel.

**Page 138, line 20 through page 139, line 3:**

When the base station Z of Figure 98 receives the functional quality and maintenance message on the common access channel tone from the remote station X that it has polled, it performs spectral and spatial despreading of the signal in the spectral and spatial despreading processor 312 and trellis decoding of the signal in the trellis decoder 314 to obtain a common access channel vector bearing the functional quality and maintenance data. The functional quality and maintenance data are then stored in the functional quality and maintenance archive buffer 320, organized by each responding remote station.

**Page 141, line 9 through page 142, line 3:**

Figure 99 is a flow diagram 700 of the sequence of operational steps for the invention. In step 710, the remote station monitors and buffers the functional quality data, including the SINR and path loss for sessions with the base station. In step 720, the remote station monitors and buffers the maintenance data, including self-test results and battery status, for the remote station. In step 730, the base station transmits a polling signal on the common link channel tone to the remote station. In step 740, the remote station accesses the functional quality data and the maintenance data from its buffers, assembles the data into a message vector, and transmits it on the common access channel tone to the base station. The remote station simultaneously

transmits data traffic channel tones to the base station. In step 750, the base station performs spectral and spatial despreading of the common access channel tone and the data traffic tones. In step 760, the base station performs trellis decoding to recover the common access channel vector bearing the functional quality and maintenance message. In step 770, the base station archives the functional quality and maintenance data. In step 780, the base station analyzes the functional quality data and updates the despreading and spreading weights to maximize the quality of the channels it establishes with the remote station. In step 790, the base station analyzes the maintenance data and outputs maintenance notices to repair or replace failing components at the remote station. In this manner, functional quality and maintenance data can be communicated from the remote stations to the base station without adversely affecting the transmission of messages having greater time criticality.

**Page 153, in the Brief Description of the Drawings:**

FIGURE 100 is an architectural diagram of the personal wireless access network (PWAN), showing the base station Z transmitting forward pilot tones with a prearranged initial forward signal power level, to the remote station X and to the remote station Y.

FIGURE 101 is an architectural diagram of the personal wireless access network (PWAN) of Figure 100, showing the remote station X transmitting reverse pilot tones with a prearranged initial reverse signal power level, to the base station Z.

**Page 153, line 12 through 17:**

Figure 100 is an architectural diagram of the personal wireless access network (PWAN), showing the base station Z transmitting forward pilot tones with a prearranged initial forward signal power level, to the remote station X and to the remote station Y. The signal received by the remote station X has a signal power level that is less than the prearranged initial forward

signal power level, the difference being a measure of the channel loss between the base station and the remote station X. The remote station stores the value of the channel loss it measures.

**Page 154, line 1 through line 11:**

Figure 101 is an architectural diagram of the personal wireless access network (PWAN) of Figure 100, showing the remote station X transmitting reverse pilot tones with a prearranged initial reverse signal power level, to the base station Z. The signal received by the base station Z has a signal power level that is less than the prearranged initial reverse signal power level, the difference being a measure of the channel loss between the base station and the remote station X. The base station stores the value of the channel loss it measures. The base station includes a retrodirective power management unit. The base prepares despreading weights to despread the DMT-SS signals it receives from the remote station X. Then the base uses the principle of retrodirectivity to compute spreading weights for transmission of DMT-SS signals to the remote station X. The spreading weights calculated at the base station include a factor based on the measured channel loss stored at the base station, to overcome the channel loss so that forward signals transmitted to the remote station X will arrive there with a desired received signal power level.

**Page 155, line 1 through page 156, line 5:**

Figure 100 illustrates the personal wireless access network (PWAN) system described in the referenced Alamouti, et al. patent application. Two users, Alice and Bob, are located at the remote station X and will exchange their respective data messages with the base station Z. Station X is positioned to be equidistant from the antenna elements A and B, of the base station Z. Two other users, Chuck and Dave, are located at the remote station Y and also will exchange their respective data messages with the base station Z. Station Y is geographically remote from

Station X and is not equidistant from the antenna elements A and B of the base station Z. The remote stations X and Y and the base station Z use the form of the CDMA protocol known as discrete multitone spread spectrum ( DMT-SS ) to provide efficient communications between the base station and the plurality of remote station units. This protocol is designated in Figure 100 as multi-tone CDMA. In this protocol, the user's data signal is modulated by a set of weighted discrete frequencies or tones. The weights are spreading weights that distribute the data signal over many discrete tones covering a broad range of frequencies. The weights are complex numbers with the real component acting to modulate the amplitude of a tone while the complex component of the weight acts to modulate the phase of the same tone. Each tone in the weighted tone set bears the same data signal. Plural users at the transmitting station can use the same tone set to transmit their data, but each of the users sharing the tone set has a different set of spreading weights. The weighted tone set for a particular user is transmitted to the receiving station where it is processed with despreading weights related to the user's spreading weights, to recover the user's data signal. For each of the spatially separated antennas at the receiver, the received multitone signals are transformed from time domain signals to frequency domain signals. Despreading weights are assigned to each frequency component of the signals received by each antenna element. The values of the despreading weights are combined with the received signals to obtain an optimized approximation of individual transmitted signals characterized by a particular multitone set and transmitting location. The PWAN system has a total of 2560 discrete tones (carriers) equally spaced in 8 MHz of available bandwidth in the range of 1850 to 1990 MHz. The spacing between the tones is 3.125 kHz. The total set of tones are numbered consecutively from 0 to 2559 starting from the lowest frequency tone. The tones are used to carry traffic messages and overhead messages between the base station and the plurality of

remote units. The traffic tones are divided into 32 traffic partitions, with each traffic channel requiring at least one traffic partition of 72 tones.

**Page 177, in the Brief Description of the Drawings:**

Figure 102 is a network diagram of two cells engaging in a first stage of retrodirective coupling, where the base station B1 in cell 1 detects the presence of interfering signals from the remote station R2 in the neighboring cell 2. Base station B1 adjusts its transmissions in the direction of remote station R2 to diminish their signal strength.

Figure 103 is a network diagram of the two cells of Figure 102 in a second stage of retrodirective coupling, where the base station B2 in the second cell 2 detects the presence of interfering signals from the remote station R1' in the first cell 1. Base station B2 adjusts its transmissions in the direction of remote station R1' to diminish their signal strength.

Figure 104 is a network diagram of the four cells similar to Figures 1A and 1B, showing propagation of channel optimization across cell boundaries to optimize the channel characteristics throughout the entire system.

Figure 105 is a more detailed block diagram of base station B1 and remote station R1' in cell 1 and remote station R2 in cell 2, where remote station R2 is sending interfering signals to the base station B1.

Figure 106 is a detailed block diagram similar to Figure 105, showing the base station B1 sending diminished strength signals across the cell boundary, in the direction of the interfering remote station R2.

**Page 178, line 2 through line 9:**

Figure 102 is a network diagram of two cells 1 and 2, in a PWAN communications system. Base station B1 communicates with remote stations R1 and R1' using the DMT-SS protocol. The notation (B1->R1') indicates the path from base station B1 to the remote station R1', for example. The notation (R1'->B1) indicates the path from remote station R1' back to the base station B1. The notation (R2->B1) indicates the path from remote station R2 in the neighboring cell 2 to the base station B1. Base station B1 in cell 1 detects the presence of interfering signals from the remote station R2 in the neighboring cell 2. In accordance with the invention, base station B1 adjusts its transmissions in the direction of remote station R2 to diminish their signal strength.

**Page 178, line 10 through 19:**

Figure 105 is a more detailed block diagram of base station B1 and remote station R1' in cell 1 and remote station R2 in cell 2, where remote station R2 is sending interfering signals to the base station B1. Remote station R1' in the same cell as base station B1, sends data tones and pilot tones to base station B1 using the DMT-SS protocol. Remote station R2 in the neighboring cell 2 sends an interfering signal to base station B1, also using the DMT-SS protocol. The base station B1 calculates optimum weights based on all of the signals received at the base station using the adaptive processor. Since the set of tone frequencies on the receive path is the same as the set of tone frequencies on the transmit path, the despreading weights used to receive can be used to compute the spreading weights for transmission, using the principle of retrodirectivity. The adaptive processor computes the value of the despreading weights, adjusted to minimize receive sensitivity to interfering signals from remote station R2.

**Page 179, line 1 through 6:**

Figure 106 is a detailed block diagram similar to Figure 105, showing the base station B1 sending diminished strength signals across the cell boundary, in the direction of the interfering remote station R2. The spreading weights derived from the despreading weights are also adaptive, their values being adjusted to diminish the strength of signals transmitted back in the direction of the interfering signal source, R2. Null steering and code nulling are used to adjust the despreading weights and the spreading weights to adaptively minimize the exchange of interfering signals.

**Page 179, line 7 through 16:**

Figure 102 shows base station B2 communicating with remote stations R2 and R2' using the DMT-SS protocol. Figure 103 is a network diagram of the two cells of Figure 102 in a second stage of retrodirective coupling, where the base station B2 in the second cell 2 detects the presence of interfering signals from the remote station R1' in the first cell 1. Base station B2 adjusts its transmissions in the direction of remote station R1' to diminish their signal strength. When adaptive retrodirectivity is used to determine the set of weights for both reception and transmission in each cell of the network, network-wide adaptive retrodirectivity can be accomplished. The base stations and remote stations in each cell use null-steering and code nulling to diminish their interference with stations in other cells. The retrodirective formation of spreading weights from despreading weights in each station propagates channel optimization across cell boundaries.

**Page 179, line 17 to 19:**

Figure 104 is a network diagram of the four cells 1, 2, 3, and 4, similar to Figures 1A and 1B, showing propagation of channel optimization across cell boundaries to optimize the channel characteristics throughout the entire system.

**Page 180, line 1 through 15:**

Figure 102 also shows how the remote station R2 in cell 2 responds to the presence of interference signals it detects from the base station in cell 1, to optimize the multiple cell network for inter-cell interference. As was discussed above, base station B1 is receiving a first spread signal comprising a first data signal spread over a plurality of discrete tones received over a first path (R1'->B1) from remote station R1' located in cell 1. The first signal further includes an interfering signal spread over the plurality of discrete tones received over an interference path (R2->B1) from remote station R2 located in cell 2. Base station B1 is adaptively despreading the signal received by using first despreading codes that are based on the characteristics of the received spread signal over the first path (R1'->B1) and over the interference path (R2->B1). The base station B1 then is spreading a second data signal with first spreading codes derived from the despreading codes based on the retrodirectivity of the first path (R1'->B1) and of the interference path (R2->B1). The first spreading codes are distributing the second data signal over a plurality of discrete tones, forming a second spread signal that is selectively diminished in the interfering path (B1->R2) to the second remote station R2. Then base station B1 continues by transmitting the second spread signal over the first path (B1->R1') to the first remote station R1' and transmitting the second signal selectively diminished over the interference path (B1->R2) to the second remote station R2.

**IN THE CLAIMS**

Please cancel original claims 1-10, 61-70, 113-122, and 157-233.

**REMARKS**

This is a preliminary amendment to a continuation application of copending parent application serial number 08/993,721, filed December 18, 1997. Note that the parent application serial number 08/993,721 has not been abandoned.

Original claims 1-10, 61-70, 113-122, and 157-233 are canceled as non-elected claims, and claims 11-60, 71-112, 123-156 and 234-265 remain in the case.

No new matter is presented in the foregoing amendments. The amendments to the specification are set forth to render the specification and drawings consistent with the parent application. Applicants respectfully request entry of the amendments. A marked-up copy of the amendments to the specification is attached hereto as APPENDIX I.

If any other fees are required for the filing of this Preliminary Amendment, please charge same to Deposit Account No. 13-4503, Order No. 4271-4036US3.

Respectfully submitted,

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## APPENDIX

### MARKED-UP VERSION OF AMENDMENTS

Page 16, line 16, after “spectral and spatial weights.”, please ADD the following text:

--FIGURE 86 is a block diagram of a plurality of remote stations coupled to a base station over a wireless link using discrete multitone spread spectrum communication and incorporating the principles of the present invention.

FIGURE 87 is a block diagram of a base station included in FIGURE 86.

FIGURE 88 is a flow diagram which implements the operation of the invention of FIGURES 86 and 87.

FIGURE 89 is an architectural diagram of the PWAN system, including remote stations transmitting to a base station.

FIGURE 90 is an architectural diagram of the remote station X as a sender.

FIGURE 91 is an architectural diagram of the base station Z as a receiver.

FIGURE 92 is a more detailed architectural diagram of the priority message processor 204 at the sending station.

FIGURE 93 is a flow diagram showing the remote station as the sender and the base station as the receiver.

FIGURE 94 is a more detailed architectural diagram of the priority message processor 320 at the receiving station.

FIGURE 95 is an architectural diagram of the PWAN system, showing the base station polling a remote station over the common link channel.

FIGURE 96 is an architectural diagram of the PWAN system, showing the remote station transmitting a functional quality and maintenance message to the base station over the common access channel.

FIGURE 97 is an architectural diagram of the remote station X as a sender of functional quality and maintenance data.

FIGURE 98 is an architectural diagram of the base station Z as a receiver of functional quality and maintenance data.

FIGURE 99 is a flow diagram of the sequence of operational steps for the invention.

FIGURE 100 is an architectural diagram of the personal wireless access network (PWAN), showing the base station Z transmitting forward pilot tones with a prearranged initial forward signal power level, to the remote station X and to the remote station Y.

FIGURE 101 is an architectural diagram of the personal wireless access network (PWAN) of FIGURE 100, showing the remote station X transmitting reverse pilot tones with a prearranged initial reverse signal power level, to the base station Z.

FIGURE 102 is a network diagram of two cells engaging in a first stage of retrodirective coupling, where the base station B1 in cell 1 detects the presence of interfering signals from the remote station R2 in the neighboring cell 2. Base station B1 adjusts its transmissions in the direction of remote station R2 to diminish their signal strength.

FIGURE 103 is a network diagram of the two cells of FIGURE 102 in a second stage of retrodirective coupling, where the base station B2 in the second cell 2 detects the presence of interfering signals from the remote station R1' in the first cell 1. Base station B2 adjusts its transmissions in the direction of remote station R1' to diminish their signal strength.

FIGURE 104 is a network diagram of the four cells similar to FIGURES 1A and 1B, showing propagation of channel optimization across cell boundaries to optimize the channel characteristics throughout the entire system.

FIGURE 105 is a more detailed block diagram of base station B1 and remote station R1' in cell 1 and remote station R2 in cell 2, where remote station R2 is sending interfering signals to the base station B1.

FIGURE 106 is a detailed block diagram similar to FIGURE 105, showing the base station B1 sending diminished strength signals across the cell boundary, in the direction of the interfering remote station R2.—

**Page 96, lines 18 to 29:**

Figure 85A, consisting of Figures 85 A-L and 85 A-R, is a flow diagram of a preferred embodiment, describing the computational steps performed in the base station. In the transmission portion of the base station, traffic symbols are input on line 5 to the smear matrix step 10. Link maintenance pilot signals are input on line 7 to the digital signal processor (DSP) data processing RAM 12. Stored pilot signals are output from the RAM 12 to the link maintenance pilot (\*LMP) register 14 and are then applied as one input to the smear step 10. The smear matrix 16 is also applied to the smear step 10. The output of the smear matrix 16 is also applied to the smear step 10. The output of the smear step 10 is applied to the gain emphasis step 20. The values from the gain RAM25 are applied to the gain emphasis step 20 to provide output values which are then applied to the beam form spreading step 30. Spreading weights in a spread weight RAM 32 are applied to the beam form spread step. The X vector is

output on line 40 from the beam form spread step and is sent to the transmitter for transmission to the remote station.

**Page 97, lines 25 through 36:**

Figure 85B, consisting of Figures 85B-L and 85B-R, shows the processing of the common access channel signals. Two common access signals (CAC) signals from the transmitter are processed. A first signal is processed being received on the input line 102 and is applied to the RMGS auto-correlation step 104, whose output goes to the digital signal matrix step 106 whose output goes to the digital signal processor. The common access channel signal online 102 is also applied to the select ungated packets step 108 and to the select gated packets step 110. The output of the select ungated packets 108 is applied to the subtract even/odd packets step 112. The output of the selected gate packets 110 is applied to the apply code key step 114. The CAC code key step 116 applies it's value to the apply code key step 114. the output of the apply code key step 114. The output of the apply code key step 114 is also applied to the subtract even/odd packets step 112. The output of the subtract even/odd packets step 112 ids applied to the RMGS autocorrelation step 118, whose output is also applied to the compute T matrix step 106. The output of the compute T matrix step 106 is then applied to the digital signal processor.

**Page 106, the Brief Description of the Drawings Section:**

Figure [A1]86 is a block diagram of a plurality of remote stations coupled to a base station over a wireless link using discrete multitone spread spectrum communication and incorporating the principles of the present invention.

Figure [A2]87 is a block diagram of a base station included in Figure [A1]86.

Figure [A3]88 is a flow diagram which implements the operation of the invention of Figures [A1 and A2]86 and 87.

**Page 106, line 15 through page 107, line 2:**

In Figure [A1]86, a remote station “X” and a remote station “Y” are coupled to a base station “Z” over a wireless link using traffic channels for data traffic, and a common access channel (CAC) and a common link channel (CLC) for control information. Each remote station includes a plurality of subscribers coupled to a transmitter/receiver which uses the discrete multitone spread spectrum protocol for transmissions. Communication between the remote stations and the base station is performed in the manner described in the above cited S. Alamouti et al. and E. Hoole et al. applications.

**Page 109, line 6 through line 14:**

In Figure [A2]87, a base station further includes a spectral and spatial despreading processor 312 which interacts with the spreading and despreading databases in accordance with the S. Alamouti et al. application previously cited. The processor is coupled to a decoder which provides an output to a vector disassembly buffer 316 for generating subscriber data originated in a call. The decoder is also coupled to a subscriber database buffer which contains information related to the subscriber name, number and other standard subscriber information including, for example, subscriber profiles. The output of the database buffer is provided to a call set up

processor 330 or an error processor 322 as will be described in more detail hereinafter. The processors 330 and 322 are connected to the network switch 202.

**Page 109, line 15 through page 110, line 15:**

The operation of Figures [A1 and A2] 86 and 87 will now be described in conjunction with Figure [A3]88. In step 710, a subscriber coupled to a remote station originates a call which initiates an "off hook" condition at the station. A set up connection request is initiated by the remote station in a step 720. The remote station transmits setup request message; the remote station ID and subscriber line number to the base station using a CAC tone. The base station responds to the set up connection request in step 730 and accesses the database 320 to identify the subscriber and obtain the subscriber profile. Simultaneously, in steps 740 and 743, the base station initiates the establishment of a traffic channel to the remote station and sends the set up request; remote user ID, subscriber line number and subscriber profile to the network switch 202. The network switch initiates the set up in a step 745 and provides dial tone to the subscriber at the remote station. During the process of establishing the traffic channel, the base station performs a test in a step 742 to determine whether a traffic channel has been established between the remote station and the base station. In some instances, the radio propagation characteristics of the channel are such that a link cannot be established. In the event that a link cannot be established, a "no" condition from the test 742 activates the error processor 322 which provides the network switch in a step 744 with a signal to a logic device which signals the network switch to disassemble or "tear down" the call set up in the PSTN, if the base station has sent the set up request message. In response to the logic device signal, the network switch in a step 749 "tears down" the PSTN connections and the process ends. In the instance where the traffic channel is

completed, a "yes" condition sends a signal to a logic device whereupon the network switch completes the call in a step 747, provided the call setup has been initiated and dial tone provided to the subscriber by the network switch.

**Page 117, the Brief Description of the Drawings Section:**

Figure [B1]89 is an architectural diagram of the PWAN system, including remote stations transmitting to a base station.

Figure [B2]90 is an architectural diagram of the remote station X as a sender.

Figure [B3]91 is an architectural diagram of the base station Z as a receiver.

Figure [B4]92 is a more detailed architectural diagram of the priority message processor 204 at the sending station.

Figure [B5]93 is a flow diagram showing the remote station as the sender and the base station as the receiver.

Figure [B6]94 is a more detailed architectural diagram of the priority message processor 320 at the receiving station.

**Page 118, line 1 through line 22:**

Figure [B1]89 is an architectural diagram of the personal wireless access network (PWAN) system described in the referenced Alamouti, Stolarz, et al. patent application. Two users, Alice and Bob, are located at the remote station X and wish to transmit their respective data messages to the base station Z. Station X is positioned to be equidistant from the antenna elements A, B, C, and D of the base station Z. Two other users, Chuck and Dave, are located at the remote station Y and also wish to transmit their respective data messages to the base station Z. Station Y is geographically remote from Station X and is not equidistant from the antenna

elements A, B, C, and D of the base station Z. The remote stations X and Y and the base station Z use the form of the CDMA protocol known as discrete multitone spread spectrum ( DMT-SS ) to provide efficient communications between the base station and the plurality of remote station units. This protocol is designated in Figure B1 as multi-tone CDMA. In this protocol, the user's data signal is modulated by a set of weighted discrete frequencies or tones. The weights are spreading weights that distribute the data signal over many discrete tones covering a broad range of frequencies. The weights are complex numbers with the real component acting to modulate the amplitude of a tone while the complex component of the weight acts to modulate the phase of the same tone. Each tone in the weighted tone set bears the same data signal. Plural users at the transmitting station can use the same tone set to transmit their data, but each of the users sharing the tone set has a different set of spreading weights. The weighted tone set for a particular user is transmitted to the receiving station where it is processed with despreading weights related to the user's spreading weights, to recover the user's data signal. For each of the spatially separated antennas at the receiver, the received multitone signals are transformed from time domain signals to frequency domain signals. Despreading weights are assigned to each frequency component of the signals received by each antenna element. The values of the despreading weights are combined with the received signals to obtain an optimized approximation of individual transmitted signals characterized by a particular multitone set and transmitting location.

**Page 120, line 15 through page 121, line 11:**

The following describes the operation of the remote station X in sending system management messages to the base station Z. The remote station and the base station are part of a wireless discrete multitone spread spectrum communications system. The remote station, which

is the sending station in this example, includes a priority message processor 204 shown in Figure [B2]90 and in Figure [B4]92, that selects the order in which system management messages are transmitted over the link control channel (LCC). The order of selection is by the time criticality of the message. Those messages having a greater time criticality are selected to be transmitted first. The priority message processor 204 in the sending station is programmed by program 400 of Figure [B4]92, to rank call control messages, connect messages, acknowledgement messages for call control, and signaling messages, for example, to have a greater time criticality than system status messages or software downloads have. The burst size transmitted from a sending station is a fixed number of bits long, for example forty-eight bits in length. If the message to be sent is longer than the burst size, then the priority message processor 204 at the sending station uses the priority message buffer 420 in Figure [B4]92, to break the message into segments. In accordance with the invention, a priority interrupt flag "P" of one bit in length is included with each message segment, to identify whether the segment is the first occurring segment in a message. A first segment of a message, with a priority interrupt flag bit  $P = 1$ , will be sent in a first occurring transmit burst time. The remaining segments that are not the first segment of a message, those segments with a priority interrupt flag bit  $P = 0$ , will be sent in a later occurring transmit burst times. This enables the sending station and the receiving station to cooperate in managing the communication of system management messages having differing time criticality.

**Page 122, lines 11 through 22:**

In accordance with the invention, the base station Z of Figure [B3]91 receives the burst with the first spread signal and the second spread signal. The base station adaptively despreads the first spread signal received by using despreading weights in the spectral and spatial

despreading processor 312, recovering the data portion. The base station also adaptively despreads the second spread signal received by using despreading weights, recovering the message segment portion and the priority interrupt flag portion. The base station includes a priority message processor 320 shown in Figure [B3]91 and in Figure [B6]94, that receives from the link control channel, the first message segment of the call control message. The priority message processor 320 at the base station then resets a message segment buffer 322 in the base station and stores the first segment of the call control message in the buffer 322, if the priority interrupt flag "P" has a first value of one. The first value of one for the priority interrupt flag "P" corresponds to a time critical message segment. This operation effectively substitutes the more time critical call control message for the first, status message at the base station Z.

**Page 123, lines 7 through 20:**

In an alternate embodiment of the invention, the base station's priority message processor 320 of Figure [B6]94, selectively reassigns its message processing capacity from low priority messages it is currently transmitting, to more time critical messages that it receives on the link control channel. In accordance with the invention, the base station Z is currently transmitting a transmitted spread signal comprising an outgoing data traffic signal spread over a plurality of discrete traffic frequencies and an outgoing message segment signal spread over a plurality of link control frequencies. This takes place during the transmit interval of a time division duplex session with the remote station X. The outgoing message segment signal from the base station is part of a low priority message, such as a software download to the remote station. During the next receive interval of the time division duplex session, the base station Z receives a spread signal comprising an incoming data traffic signal spread over a plurality of discrete traffic

frequencies and an incoming message segment signal spread over a plurality of link control frequencies. The base station adaptively despreads the signals received at the base station by using despreading weights in its spectral and spatial despreading processor 312 of [figure B3]Figure 91. Then the base station's priority message processor 320 of Figure [B6]94, detects a priority interrupt flag value "P" in the message segment signal.

**Page 123, line 21 through page 124 line 19:**

In accordance with the alternate embodiment of the invention, the base station's priority message processor 320 acts to reassign the station's message processing capacity by interrupting the next scheduled transmission of the second outgoing message segment signal. An example where this operation is required is when the remote station X sends a call control message to the base station that requires the base station to quickly respond with a reply message. The priority message processor 320 detects the priority interrupt flag  $P = 1$  in the first segment of the call control message, and in response, resets the message segment buffer 322 in the base station. The priority message processor 320 stores the incoming message segment signal in the message segment buffer 322. The priority message processor 320 of Figure [B6]94, determines that the call control message received from the remote station requires a quick reply. In response to this, the priority message processor 320 at the base station stores the last segment number sent for the low priority outgoing message it has been sending to the remote station. The base station can then transmit its reply message to the remote station. In this manner, quick reply message can be sent in response to request messages. After the reply message has been sent by the base station, the last segment number sent for the low priority outgoing message is retrieved by the priority message processor 320 and transmission is resumed by the base station, starting with the

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next segment number for the low priority outgoing message. Alternately, the base station concatenates the incoming message segment signal with a previously received message segment, if the priority interrupt flag has a second value of zero. The second value of zero for the priority interrupt flag corresponds to a message segment that is not a first message segment in a message having plural segments. In this manner, the invention manages the exchange of system management messages over the link control channel between a remote station and the base station so that time critical system management messages are given priority over those that are not time critical.

**Page 124, line 20 through page 125, line 6:**

In Figure [B2]90, Alice and Bob each input data to remote station X. The sender's traffic data is sent to the vector formation buffer 202 and the sender's system management information is sent to the priority message processor 204, shown in greater detail in Figure [B4]92. Data vectors are output from buffer 202 to the trellis encoder 206. The data vectors are in the form of a 48-bit data message segment per transmit burst. The LCC vectors output from the priority message processor 204 to the trellis encoder 206 are in the form of a 48-bit priority message segment per transmit burst, formed by concatenating a 47-bit message segment with the one-bit priority interrupt flag. The trellis encoded data vectors and LCC vectors are then output to the spectral spreading processor 208. The resultant data tones and LCC tones are then output from processor 208 to the transmitter 210 for transmission to the base station.

**Page 125, lines 7 through 13:**

The first four steps in the flow diagram 700 of Figure [B5]93 show the steps at remote station X when it is the sender. The steps in the method of transmission from a remote station

to a base station are first for the Remote Station in step 710 to generate a priority message segment in the priority message processor 204 of figure [B4]92 and input it as a vector to the link control channel. Then in step 720, the Remote Station performs trellis encoding of the link control channel vector and the data vectors. Then in Step 730, the Remote Station performs spectral spreading of the trellis encoded link control channel vector and data vectors. Then in Step 740, the Remote Station transmits the link control channel tone and data tones to the base station.

**Page 127, lines 6 through 13:**

Figure [B3]91 is an architectural diagram of the base station Z as a receiver. The data tones and LCC tones are received at the base station antennas A, B, C, and D. The receiver 310 passes the data tones and the LCC tones to the spectral and spatial despreading processor 312. The despread signals are then output from the processor 312 to the trellis decoder 314. The data vectors are then output to the vector disassembly buffer 316. The LCC vectors are output to the priority message processor 320, shown in greater detail in Figure 94. Alice's data and Bob's data are output from the buffer 316 to the public switched telephone network (PSTN). Priority message segments are passed from the priority message processor 320 to the priority message buffer 322. There the segments are concatenated into a full message 325 to be output on line 330.

**Page 127, line 14 through page 128, line 2:**

The last five steps in the flow diagram 700 of Figure [B5]93, show the base station Z as the receiver. In Step 750, the Base Station performs spectral and spatial despreading of the link

control channel tone and data tones. Then, in Step 760, the Base Station performs trellis decoding of despread link control channel tone and data tones. Then in Step 770, the Base Station's priority message processor 320 determines if the priority interrupt flag  $P = 1$ . If it does, then priority message processor 320 resets the priority message buffer 322 and loads the newly received message segment in buffer 322. In step 780, alternately, if the Base Station's priority message processor 320 determines that the priority interrupt flag  $P = 0$ , then it concatenates the newly received message segment with the previously received message segment for the same message in buffer 322. Then in Step 790, the priority message buffer 322 combines the plural message segments into a complete message and outputs it on line 330. The completed message can be processed within the base station or it can be forwarded along with the received data to the public switched telephone network.

**Page 133 to 134, the Brief Description of the Drawings:**

Figure [C1A]95 is an architectural diagram of the PWAN system, showing the base station polling a remote station over the common link channel.

Figure [C1B]96 is an architectural diagram of the PWAN system, showing the remote station transmitting a functional quality and maintenance message to the base station over the common access channel.

Figure [C2]97 is an architectural diagram of the remote station X as a sender of functional quality and maintenance data.

Figure [C3]98 is an architectural diagram of the base station Z as a receiver of functional quality and maintenance data.

Figure [C4]99 is a flow diagram of the sequence of operational steps for the invention.

**Page 134, line 5 to page 135, line 19:**

Figure [C1A]95 is an architectural diagram of the PWAN system, showing the base station polling a remote station over the common link channel. Figure [C1B]96 shows the remote station transmitting a functional quality and maintenance message to the base station over the common access channel. These are diagrams of the personal wireless access network (PWAN) system described in the referenced Alamouti, Stolarz, et al. patent applications. Two users, Alice and Bob, are located at the remote station X and wish to transmit their respective data messages to the base station Z. Station X is positioned to be equidistant from the antenna elements A, B, C, and D of the base station Z. Two other users, Chuck and Dave, are located at the remote station Y and also wish to transmit their respective data messages to the base station Z. Station Y is geographically remote from Station X and is not equidistant from the antenna elements A, B, C, and D of the base station Z. The remote stations X and Y and the base station Z use the form of the CDMA protocol known as discrete multitone spread spectrum ( DMT-SS ) to provide efficient communications between the base station and the plurality of remote station units. This protocol is designated in Figure [C1]95 as multi-tone CDMA. In this protocol, the user's data signal is modulated by a set of weighted discrete frequencies or tones. The weights are spreading weights that distribute the data signal over many discrete tones covering a broad range of frequencies. The weights are complex numbers with the real component acting to modulate the amplitude of a tone while the complex component of the weight acts to modulate the phase of the same tone. Each tone in the weighted tone set bears the same data signal. Plural users at the transmitting station can use the same tone set to transmit their data, but each of the

users sharing the tone set has a different set of spreading weights. The weighted tone set for a particular user is transmitted to the receiving station where it is processed with despreading weights related to the user's spreading weights, to recover the user's data signal. For each of the spatially separated antennas at the receiver, the received multitone signals are transformed from time domain signals to frequency domain signals. Despreading weights are assigned to each frequency component of the signals received by each antenna element. The values of the despreading weights are combined with the received signals to obtain an optimized approximation of individual transmitted signals characterized by a particular multitone set and transmitting location.

**Page 137, lines 10 through 20:**

In accordance with the invention, a new method makes the most efficient use of the scarce spectral bandwidth in a wireless discrete multitone spread spectrum communications system. Each remote station in the network collects functional quality and maintenance data for itself. During each data traffic session that a remote station has with the base station, the remote station X of Figure [C2]97 computes the signal-to-interference-and-noise ratio (SINR) as a byproduct of receiving the discrete multitone spread spectrum signals from the base station Z. The remote station stores the SINR data that it accumulates in a SINR history buffer 224. The remote station also computes the path loss of the signals received from the base station and stores the values it accumulates in a path loss history buffer 226. The remote station runs self-test programs on a periodic basis and stores the results in a self-test results buffer 220. And the remote station monitors the status of its backup battery and stores the status in a battery status

buffer 222. Other functional quality and maintenance data can also be monitored by the remote station and stored in buffers.

**Page 137, line 21 through page 138, line 11:**

In accordance with the invention, the base station Z periodically transmits a discrete multitone spread spectrum (DMT-SS) signal on the common link channel to each remote station, polling the respective remote station, as shown in Figure [C1A]95. The common link channel (CLC) is used by the base to transmit control information to the remote stations.

Simultaneously, data traffic from the public switched telephone network (PSTN) arrives at the base station Z and is converted into data traffic DMT-SS tones which are transmitted to the remote stations. In response to the base station's polling signal being received by the remote station X at its input 230, the respective remote station of Figure [C2]97, activates its polling response processor 228 to respond the poll. The polling response processor 228 accesses the self test buffer 220, the battery status buffer 222, the SINR history buffer 224, and the path loss buffer 226 to assemble a functional quality and maintenance data message. The message is formed into a common access channel vector that is input to the trellis encoder 206 and then to the spectral spreading processor 208 to produce the common access channel tone. The common access channel tone with the functional quality and maintenance data message is then transmitted by transmitter 210 as a DMT-SS signal back to the base station Z on the common access channel.

**Page 138, line 20 through page 139, line 3:**

When the base station Z of Figure [C3]98 receives the functional quality and maintenance message on the common access channel tone from the remote station X that it has polled, it performs spectral and spatial despreading of the signal in the spectral and spatial

despreading processor 312 and trellis decoding of the signal in the trellis decoder 314 to obtain a common access channel vector bearing the functional quality and maintenance data. The functional quality and maintenance data are then stored in the functional quality and maintenance archive buffer 320, organized by each responding remote station.

**Page 141, line 9 through page 142, line 3:**

Figure [C4]99 is a flow diagram 700 of the sequence of operational steps for the invention. In step 710, the remote station monitors and buffers the functional quality data, including the SINR and path loss for sessions with the base station. In step 720, the remote station monitors and buffers the maintenance data, including self-test results and battery status, for the remote station. In step 730, the base station transmits a polling signal on the common link channel tone to the remote station. In step 740, the remote station accesses the functional quality data and the maintenance data from its buffers, assembles the data into a message vector, and transmits it on the common access channel tone to the base station. The remote station simultaneously transmits data traffic channel tones to the base station. In step 750, the base station performs spectral and spatial despreading of the common access channel tone and the data traffic tones. In step 760, the base station performs trellis decoding to recover the common access channel vector bearing the functional quality and maintenance message. In step 770, the base station archives the functional quality and maintenance data. In step 780, the base station analyzes the functional quality data and updates the despreading and spreading weights to maximize the quality of the channels it establishes with the remote station. In step 790, the base station analyzes the maintenance data and outputs maintenance notices to repair or replace failing components at the remote station. In this manner, functional quality and maintenance

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data can be communicated from the remote stations to the base station without adversely affecting the transmission of messages having greater time criticality.

**Page 153, in the Brief Description of the Drawings:**

FIGURE [D1A]100 is an architectural diagram of the personal wireless access network (PWAN), showing the base station Z transmitting forward pilot tones with a prearranged initial forward signal power level, to the remote station X and to the remote station Y.

FIGURE [D1B]101 is an architectural diagram of the personal wireless access network (PWAN) of Figure [D1A]100, showing the remote station X transmitting reverse pilot tones with a prearranged initial reverse signal power level, to the base station Z.

**Page 153, line 12 through 17:**

Figure [D1A]100 is an architectural diagram of the personal wireless access network (PWAN), showing the base station Z transmitting forward pilot tones with a prearranged initial forward signal power level, to the remote station X and to the remote station Y. The signal received by the remote station X has a signal power level that is less than the prearranged initial forward signal power level, the difference being a measure of the channel loss between the base station and the remote station X. The remote station stores the value of the channel loss it measures.

**Page 154, line 1 through line 11:**

Figure [D1B]101 is an architectural diagram of the personal wireless access network (PWAN) of Figure [D1A]100, showing the remote station X transmitting reverse pilot tones with

a prearranged initial reverse signal power level, to the base station Z. The signal received by the base station Z has a signal power level that is less than the prearranged initial reverse signal power level, the difference being a measure of the channel loss between the base station and the remote station X. The base station stores the value of the channel loss it measures. The base station includes a retrodirective power management unit. The base prepares despreading weights to despread the DMT-SS signals it receives from the remote station X. Then the base uses the principle of retrodirectivity to compute spreading weights for transmission of DMT-SS signals to the remote station X. The spreading weights calculated at the base station include a factor based on the measured channel loss stored at the base station, to overcome the channel loss so that forward signals transmitted to the remote station X will arrive there with a desired received signal power level.

**Page 155, line 1 through page 156, line 5:**

Figure [D1A]100 illustrates the personal wireless access network (PWAN) system described in the referenced Alamouti, et al. patent application. Two users, Alice and Bob, are located at the remote station X and will exchange their respective data messages with the base station Z. Station X is positioned to be equidistant from the antenna elements A and B, of the base station Z. Two other users, Chuck and Dave, are located at the remote station Y and also will exchange their respective data messages with the base station Z. Station Y is geographically remote from Station X and is not equidistant from the antenna elements A and B of the base station Z. The remote stations X and Y and the base station Z use the form of the CDMA protocol known as discrete multitone spread spectrum ( DMT-SS ) to provide efficient communications between the base station and the plurality of remote station units. This protocol

is designated in Figure [D1A]100 as multi-tone CDMA. In this protocol, the user's data signal is modulated by a set of weighted discrete frequencies or tones. The weights are spreading weights that distribute the data signal over many discrete tones covering a broad range of frequencies. The weights are complex numbers with the real component acting to modulate the amplitude of a tone while the complex component of the weight acts to modulate the phase of the same tone. Each tone in the weighted tone set bears the same data signal. Plural users at the transmitting station can use the same tone set to transmit their data, but each of the users sharing the tone set has a different set of spreading weights. The weighted tone set for a particular user is transmitted to the receiving station where it is processed with despreading weights related to the user's spreading weights, to recover the user's data signal. For each of the spatially separated antennas at the receiver, the received multitone signals are transformed from time domain signals to frequency domain signals. Despreading weights are assigned to each frequency component of the signals received by each antenna element. The values of the despreading weights are combined with the received signals to obtain an optimized approximation of individual transmitted signals characterized by a particular multitone set and transmitting location. The PWAN system has a total of 2560 discrete tones (carriers) equally spaced in 8 MHz of available bandwidth in the range of 1850 to 1990 MHz. The spacing between the tones is 3.125 kHz. The total set of tones are numbered consecutively from 0 to 2559 starting from the lowest frequency tone. The tones are used to carry traffic messages and overhead messages between the base station and the plurality of remote units. The traffic tones are divided into 32 traffic partitions, with each traffic channel requiring at least one traffic partition of 72 tones.

**Page 177, in the Brief Description of the Drawings:**

Figure [E1A]102 is a network diagram of two cells engaging in a first stage of retrodirective coupling, where the base station B1 in cell 1 detects the presence of interfering signals from the remote station R2 in the neighboring cell 2. Base station B1 adjusts its transmissions in the direction of remote station R2 to diminish their signal strength.

Figure [E1B]103 is a network diagram of the two cells of Figure 102 in a second stage of retrodirective coupling, where the base station B2 in the second cell 2 detects the presence of interfering signals from the remote station R1' in the first cell 1. Base station B2 adjusts its transmissions in the direction of remote station R1' to diminish their signal strength.

Figure [E1C]104 is a network diagram of the four cells similar to Figures 1A and 1B, showing propagation of channel optimization across cell boundaries to optimize the channel characteristics throughout the entire system.

Figure [E2A]105 is a more detailed block diagram of base station B1 and remote station R1' in cell 1 and remote station R2 in cell 2, where remote station R2 is sending interfering signals to the base station B1.

Figure [E2B]106 is a detailed block diagram similar to Figure 105, showing the base station B1 sending diminished strength signals across the cell boundary, in the direction of the interfering remote station R2.

**Page 178, line 2 through line 9:**

Figure [E1A]102 is a network diagram of two cells 1 and 2, in a PWAN communications system. Base station B1 communicates with remote stations R1 and R1' using the DMT-SS protocol. The notation (B1->R1') indicates the path from base station B1 to the remote station

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R1', for example. The notation (R1'->B1) indicates the path from remote station R1' back to the base station B1. The notation (R2->B1) indicates the path from remote station R2 in the neighboring cell 2 to the base station B1. Base station B1 in cell 1 detects the presence of interfering signals from the remote station R2 in the neighboring cell 2. In accordance with the invention, base station B1 adjusts its transmissions in the direction of remote station R2 to diminish their signal strength.

**Page 178, line 10 through 19:**

Figure [E2A]105 is a more detailed block diagram of base station B1 and remote station R1' in cell 1 and remote station R2 in cell 2, where remote station R2 is sending interfering signals to the base station B1. Remote station R1' in the same cell as base station B1, sends data tones and pilot tones to base station B1 using the DMT-SS protocol. Remote station R2 in the neighboring cell 2 sends an interfering signal to base station B1, also using the DMT-SS protocol. The base station B1 calculates optimum weights based on all of the signals received at the base station using the adaptive processor. Since the set of tone frequencies on the receive path is the same as the set of tone frequencies on the transmit path, the despreading weights used to receive can be used to compute the spreading weights for transmission, using the principle of retrodirectivity. The adaptive processor computes the value of the despreading weights, adjusted to minimize receive sensitivity to interfering signals from remote station R2.

**Page 179, line 1 through 6:**

Figure [E2B]106 is a detailed block diagram similar to Figure [E2A]105, showing the base station B1 sending diminished strength signals across the cell boundary, in the direction of the interfering remote station R2. The spreading weights derived from the despreading weights are also adaptive, their values being adjusted to diminish the strength of signals transmitted back in the direction of the interfering signal source, R2. Null steering and code nulling are used to adjust the despreading weights and the spreading weights to adaptively minimize the exchange of interfering signals.

**Page 179, line 7 through 16:**

Figure [E1A]102 shows base station B2 communicating with remote stations R2 and R2' using the DMT-SS protocol. Figure [E1B]103 is a network diagram of the two cells of Figure [E1A]102 in a second stage of retrodirective coupling, where the base station B2 in the second cell 2 detects the presence of interfering signals from the remote station R1' in the first cell 1. Base station B2 adjusts its transmissions in the direction of remote station R1' to diminish their signal strength. When adaptive retrodirectivity is used to determine the set of weights for both reception and transmission in each cell of the network, network-wide adaptive retrodirectivity can be accomplished. The base stations and remote stations in each cell use null-steering and code nulling to diminish their interference with stations in other cells. The retrodirective formation of spreading weights from despreading weights in each station propagates channel optimization across cell boundaries.

**Page 179, line 17 to 19:**

Figure [E1C]104 is a network diagram of the four cells 1, 2, 3, and 4, similar to Figures 1A and 1B, showing propagation of channel optimization across cell boundaries to optimize the channel characteristics throughout the entire system.

**Page 180, line 1 through 15:**

Figure [E1A]102 also shows how the remote station R2 in cell 2 responds to the presence of interference signals it detects from the base station in cell 1, to optimize the multiple cell network for inter-cell interference. As was discussed above, base station B1 is receiving a first spread signal comprising a first data signal spread over a plurality of discrete tones received over a first path (R1'->B1) from remote station R1' located in cell 1. The first signal further includes an interfering signal spread over the plurality of discrete tones received over an interference path (R2->B1) from remote station R2 located in cell 2. Base station B1 is adaptively despreading the signal received by using first despreading codes that are based on the characteristics of the received spread signal over the first path (R1'->B1) and over the interference path (R2->B1). The base station B1 then is spreading a second data signal with first spreading codes derived from the despreading codes based on the retrodirectivity of the first path (R1'->B1) and of the interference path (R2->B1). The first spreading codes are distributing the second data signal over a plurality of discrete tones, forming a second spread signal that is selectively diminished in the interfering path (B1->R2) to the second remote station R2. Then base station B1 continues by transmitting the second spread signal over the first path (B1->R1') to the first remote station R1' and transmitting the second signal selectively diminished over the interference path (B1->R2) to the second remote station R2.

FIG. 1A

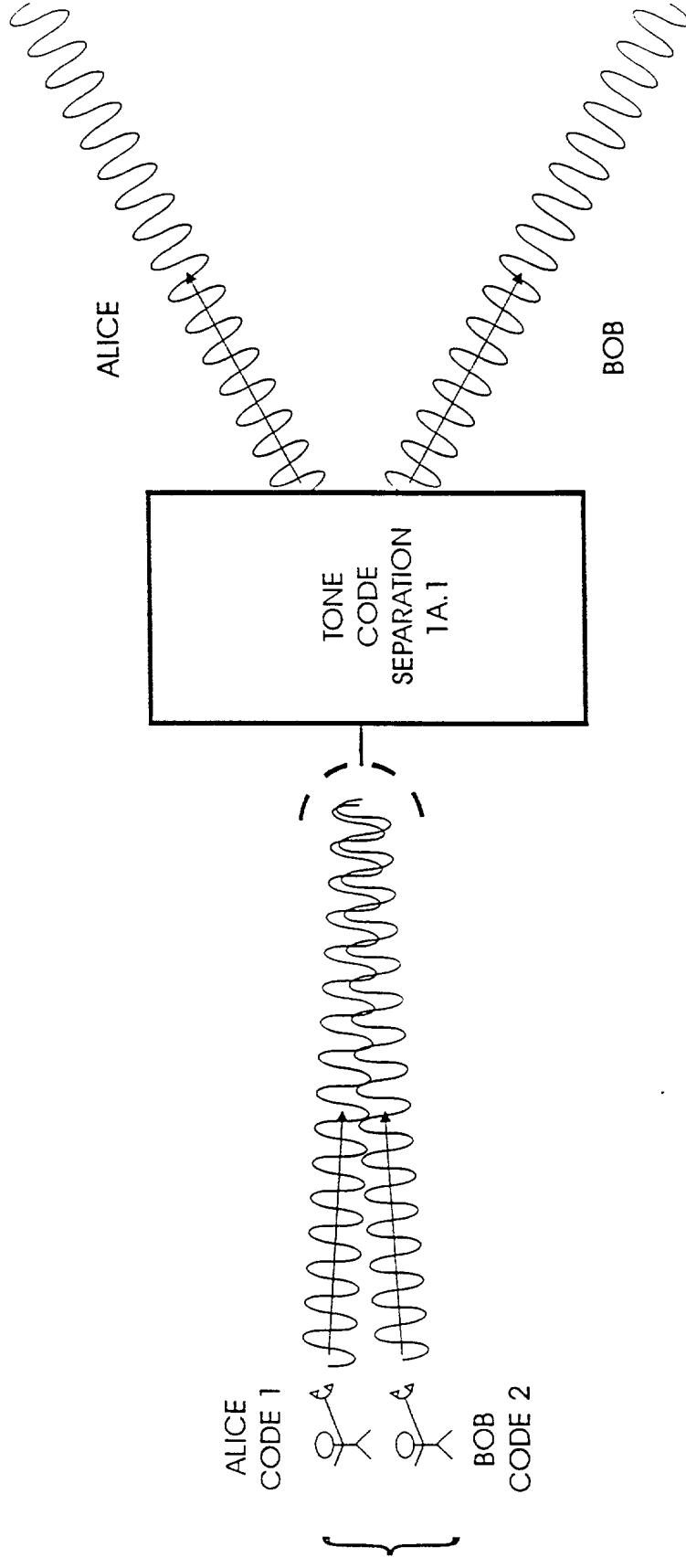


FIG. 1B

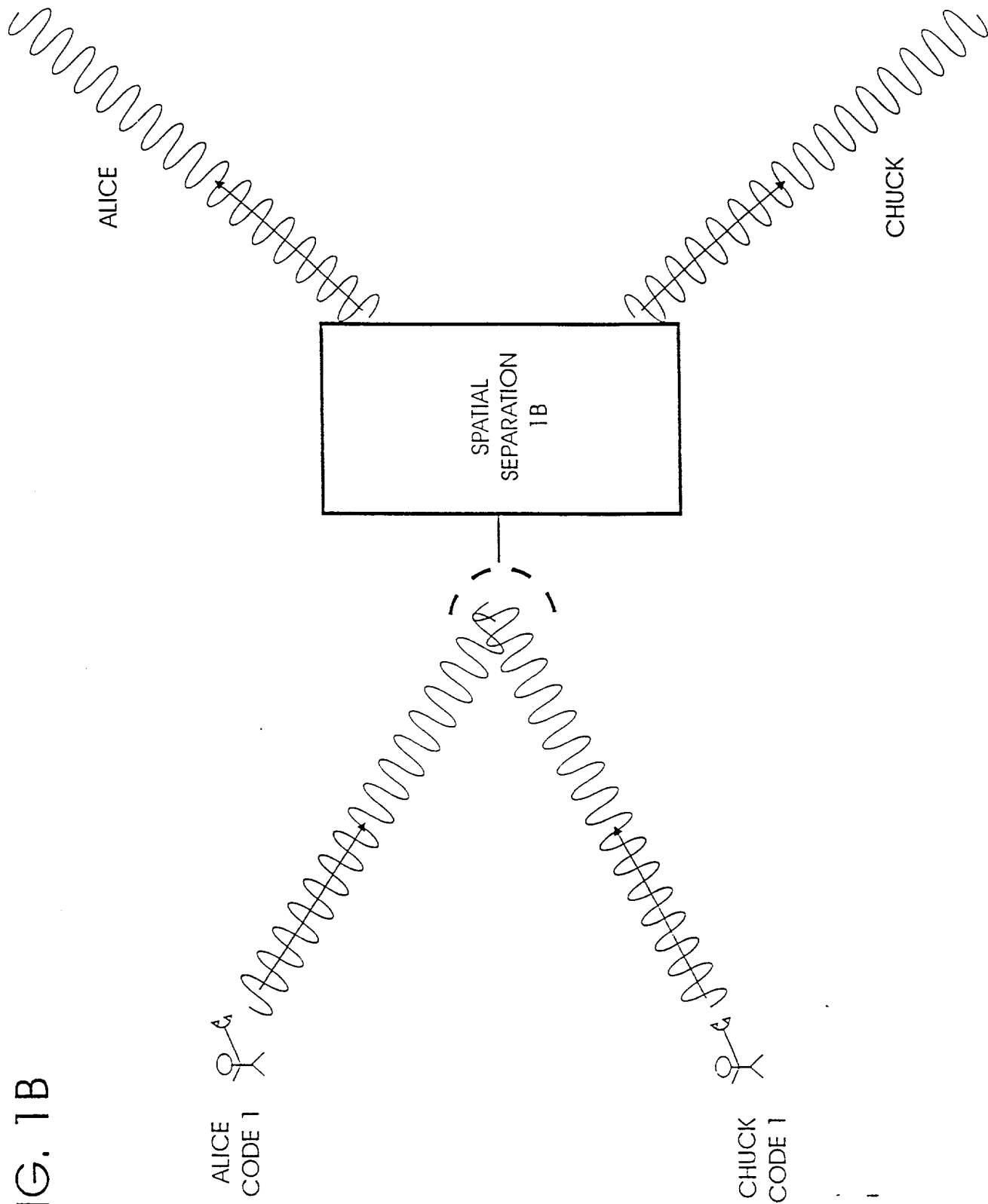


FIG. 1C

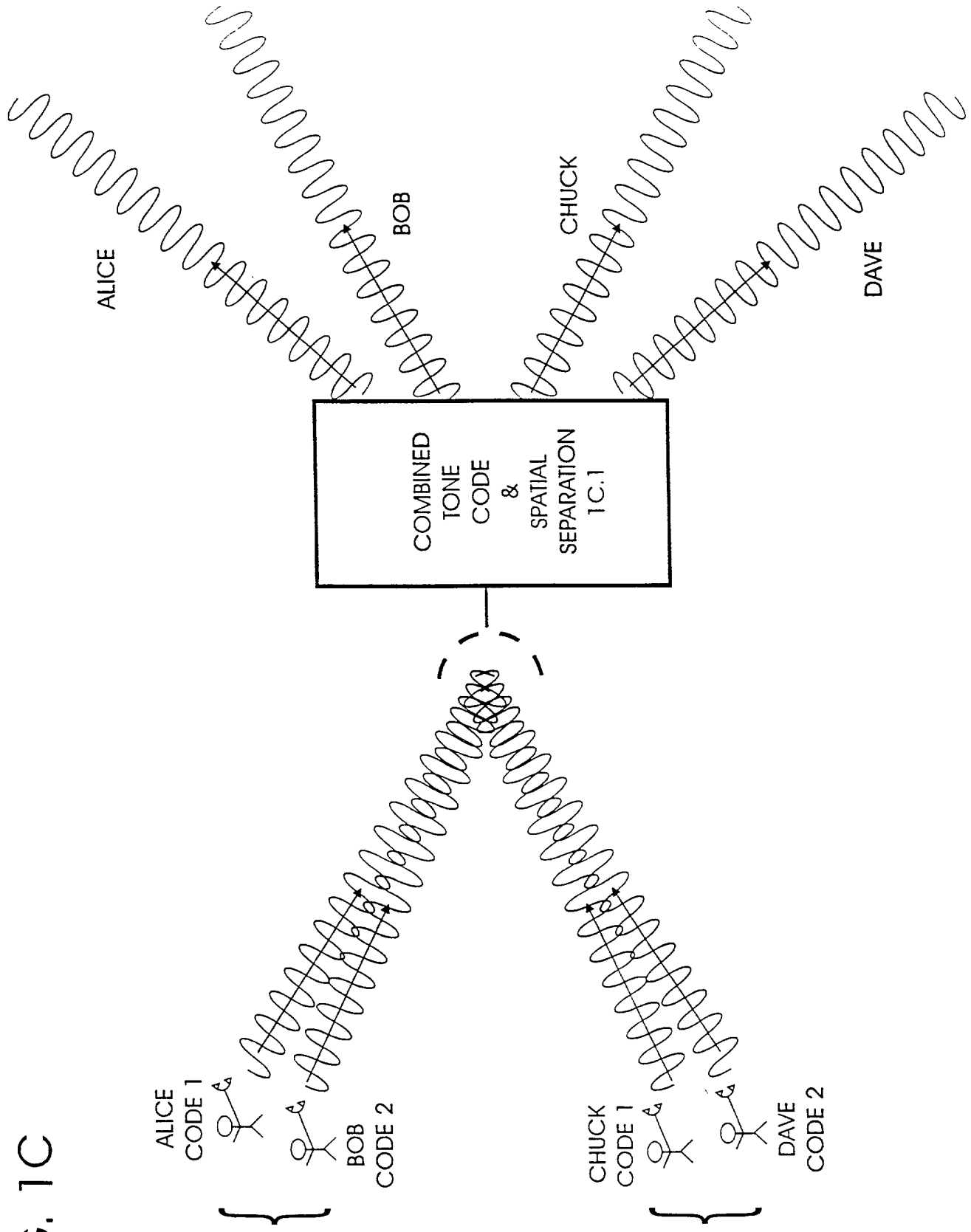


FIG. 1D

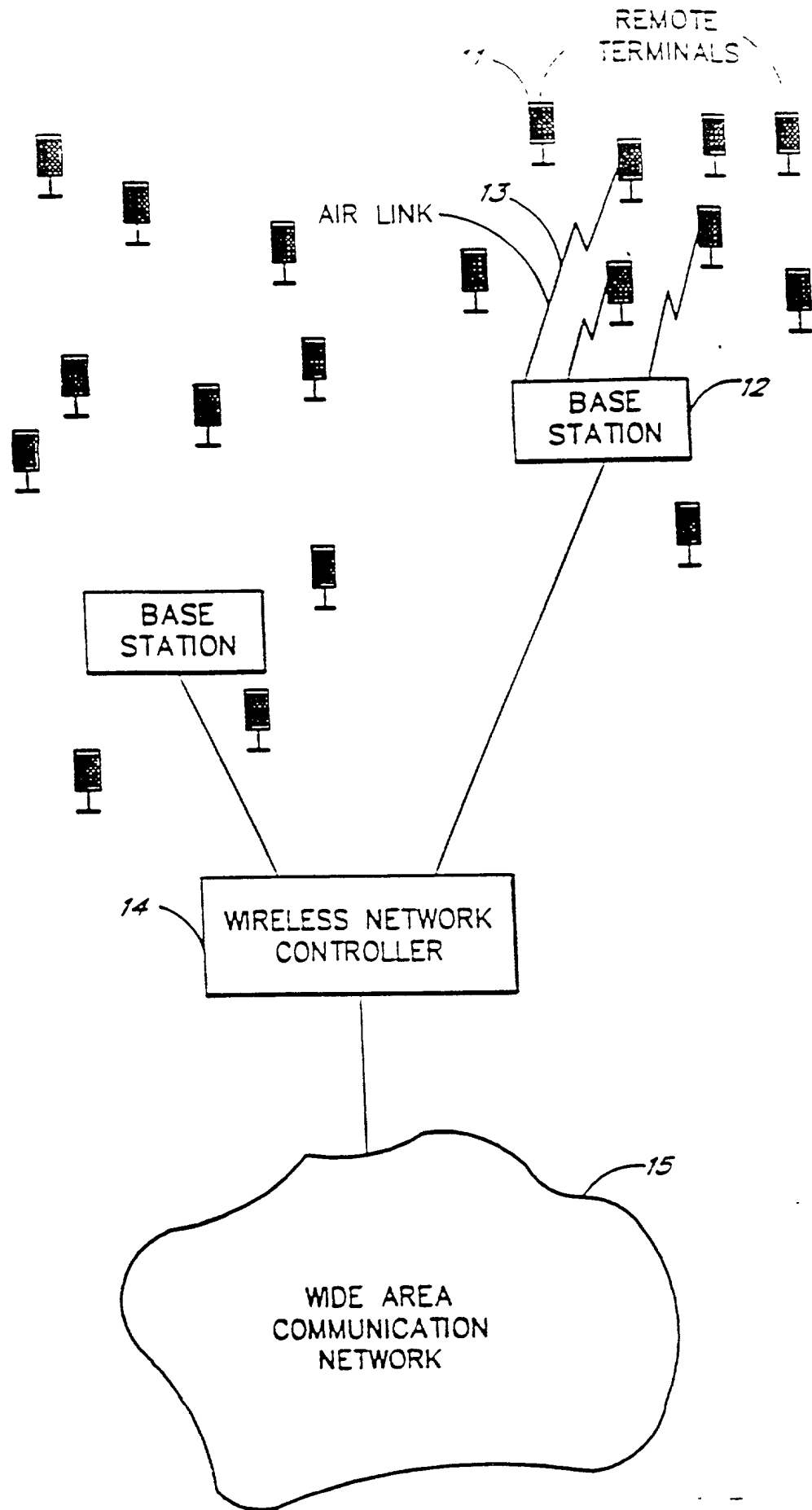


FIG. 1D

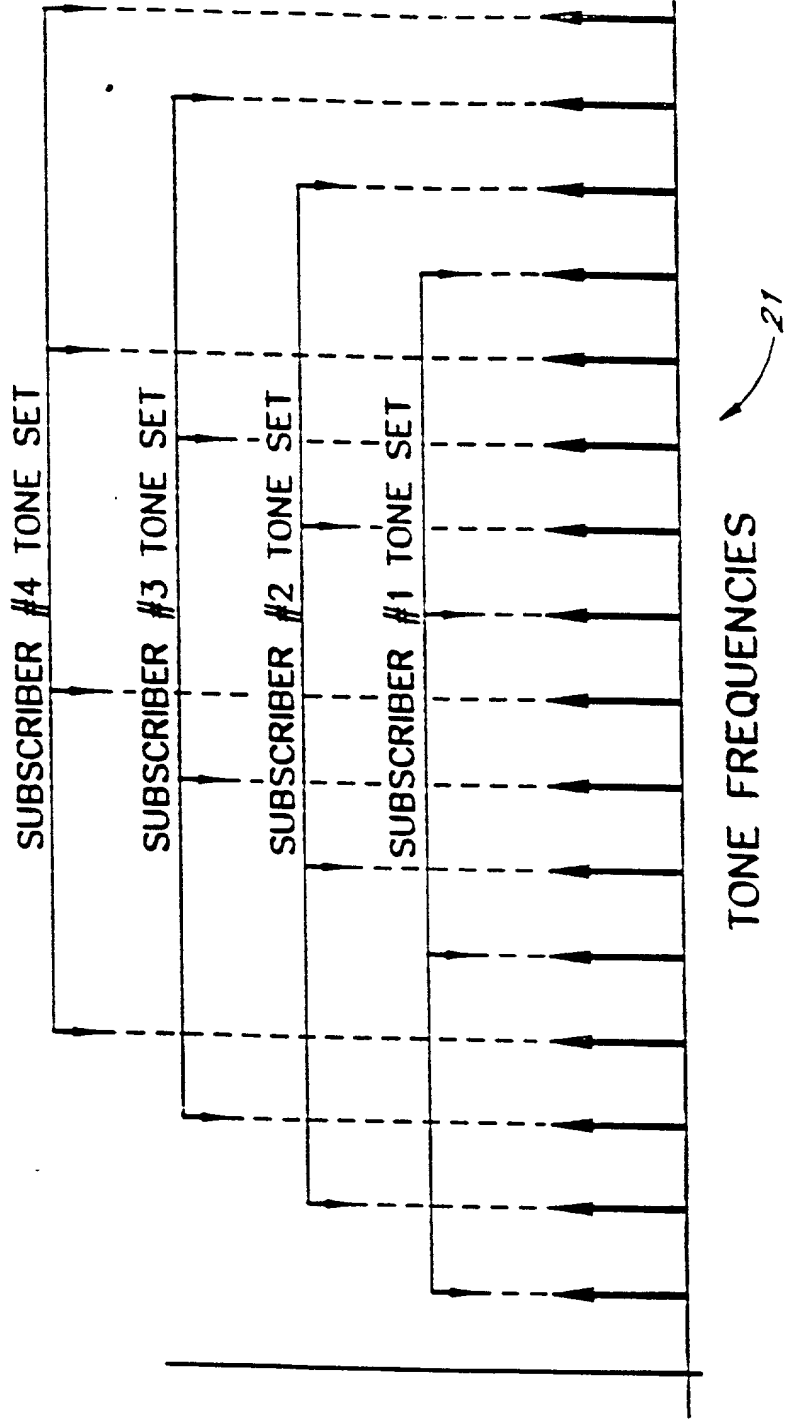


FIGURE 2

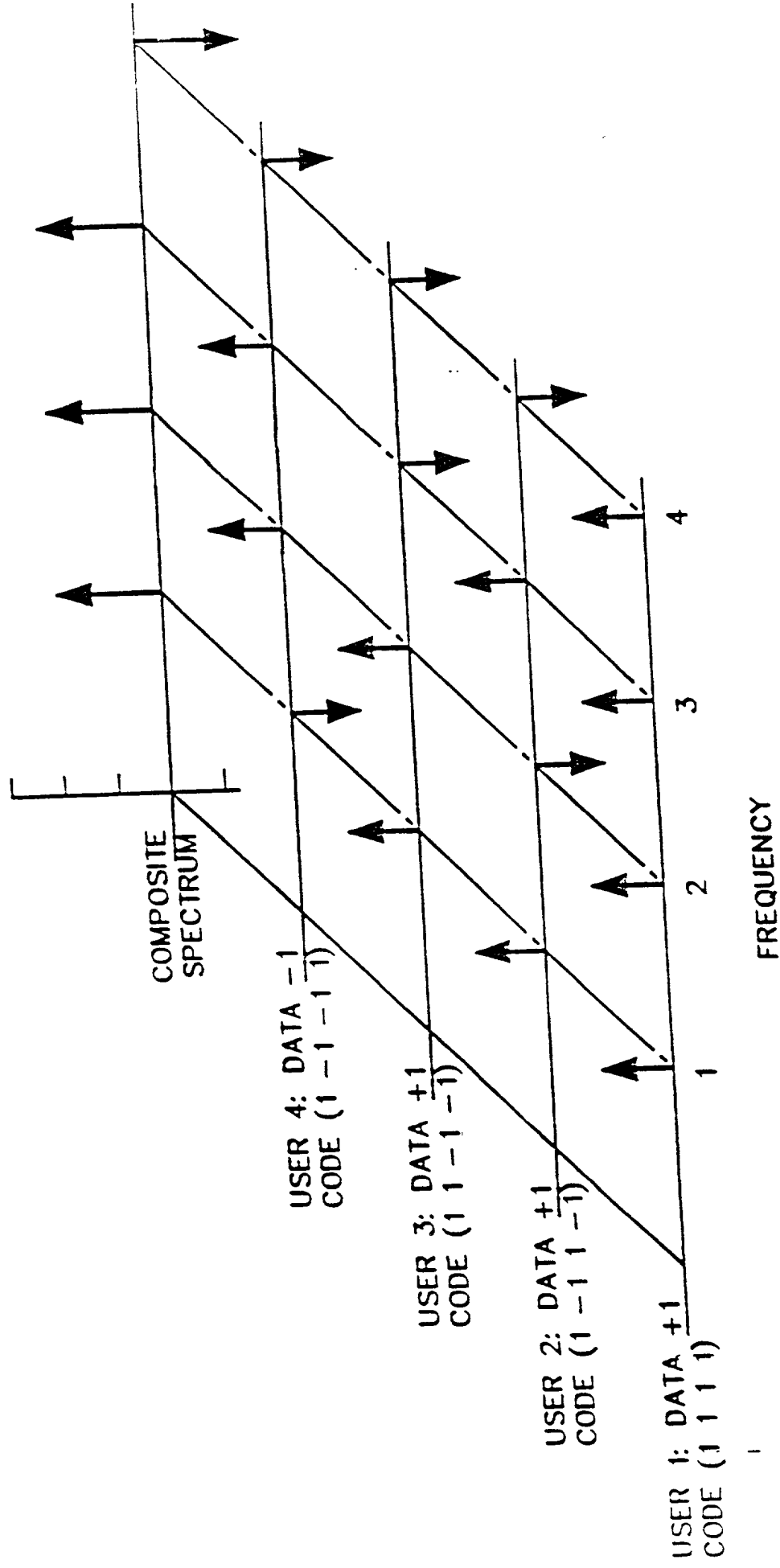
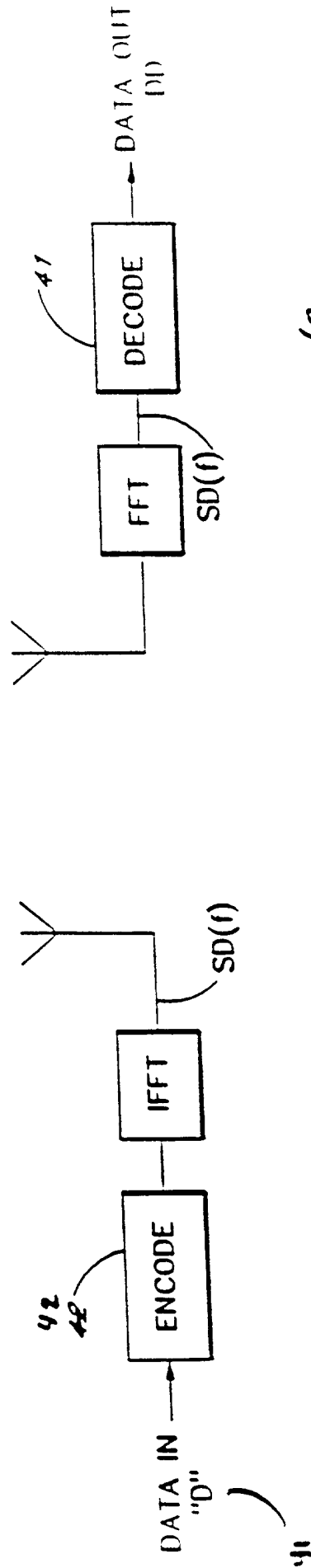


FIGURE 3



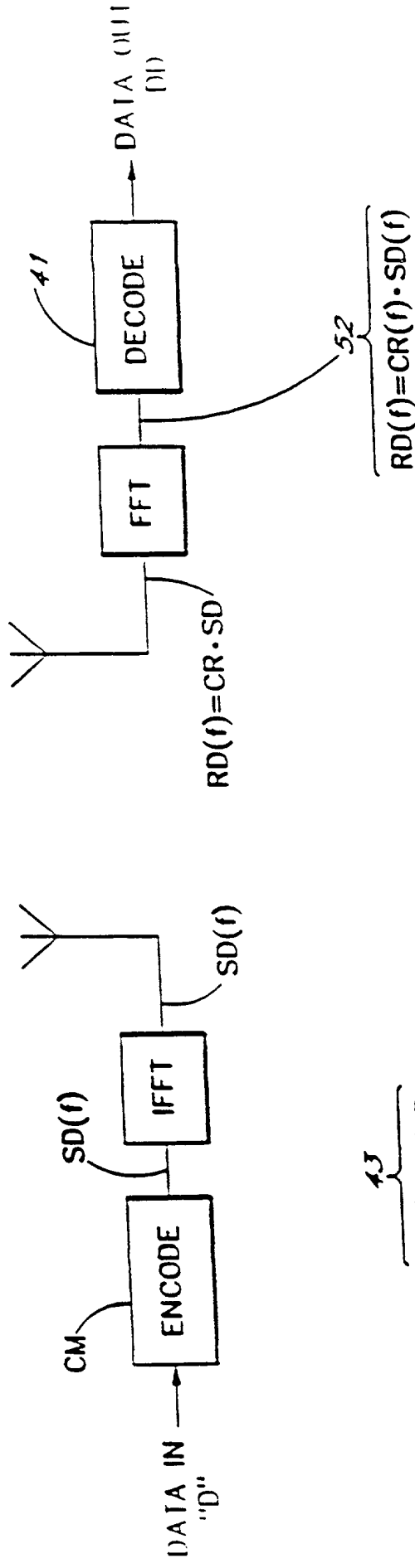
$$SD(f) = CM \cdot D$$

$$DD(f) = CM^{-1} \cdot SD(f)$$

$$SD(f) = \begin{bmatrix} 2 \\ 2 \\ 2 \\ -2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 \\ 1 \\ 1 \\ -1 \end{bmatrix}$$

$$DD = \begin{bmatrix} 1 \\ 1 \\ 1 \\ -1 \end{bmatrix} = \frac{1}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix} \cdot \begin{bmatrix} 2 \\ 2 \\ 2 \\ -2 \end{bmatrix}$$

FIGURE 4



$$\underbrace{43}_{SD(f) = CM \cdot D}$$

$$RD = \underbrace{\begin{bmatrix} 0.9 \\ 1.0 \\ 1.2 \\ 1.1 \end{bmatrix}}_{53} \cdot \begin{bmatrix} 2 \\ 2 \\ 2 \\ -2 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & -1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 \\ 1 \\ 1 \\ -1 \end{bmatrix} \quad 44$$

$$DD = \begin{bmatrix} 1.0 \\ 1.1 \\ 0.9 \\ -1.2 \end{bmatrix} = \frac{1}{4} \cdot \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & 1 & +1 \\ 1 & 1 & -1 & -1 \\ 1 & -1 & -1 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1.8 \\ 2.0 \\ 2.4 \\ -2.2 \end{bmatrix}$$

FIGURE 5

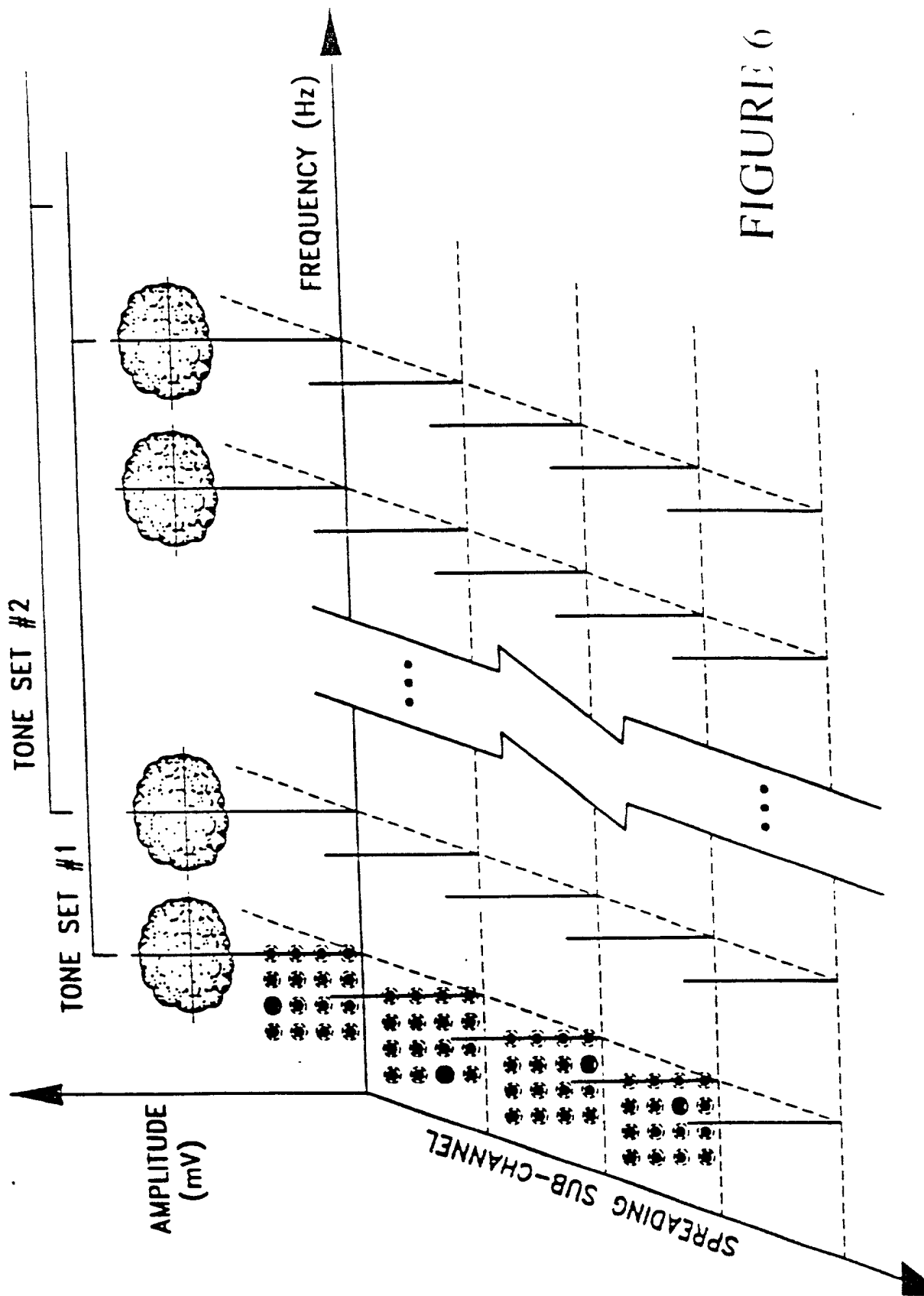


FIGURE 6

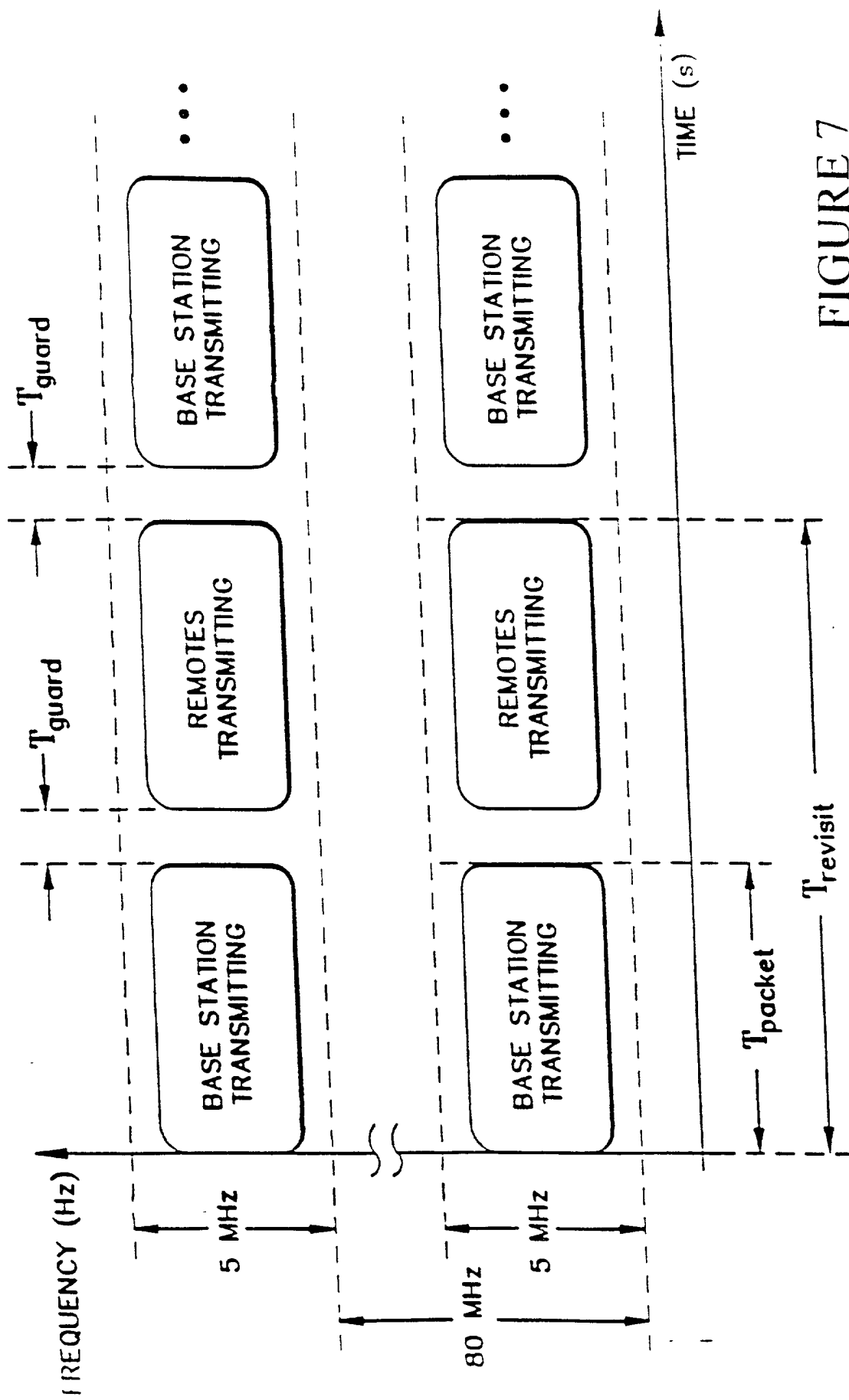


FIGURE 7

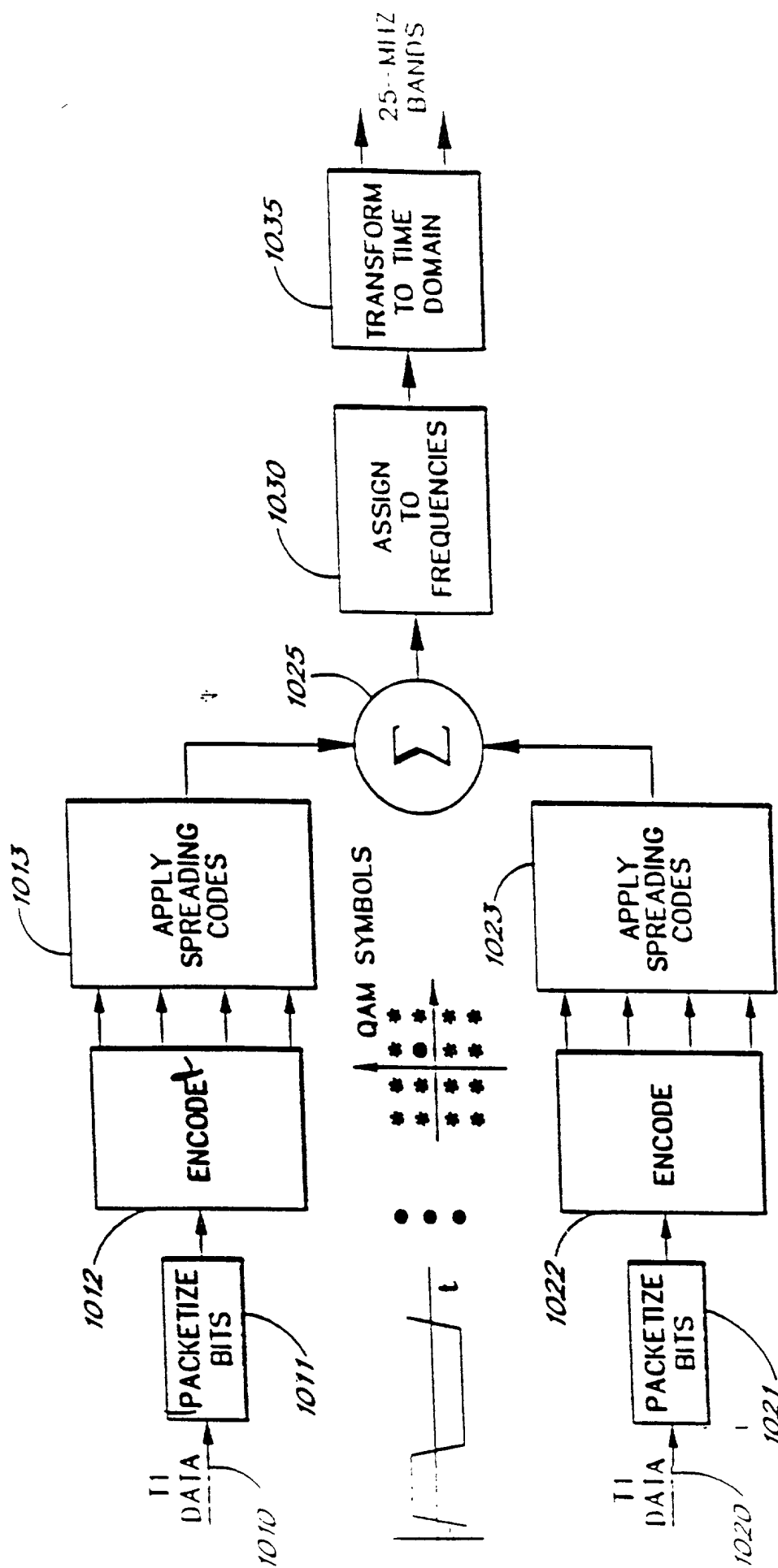


FIGURE 8

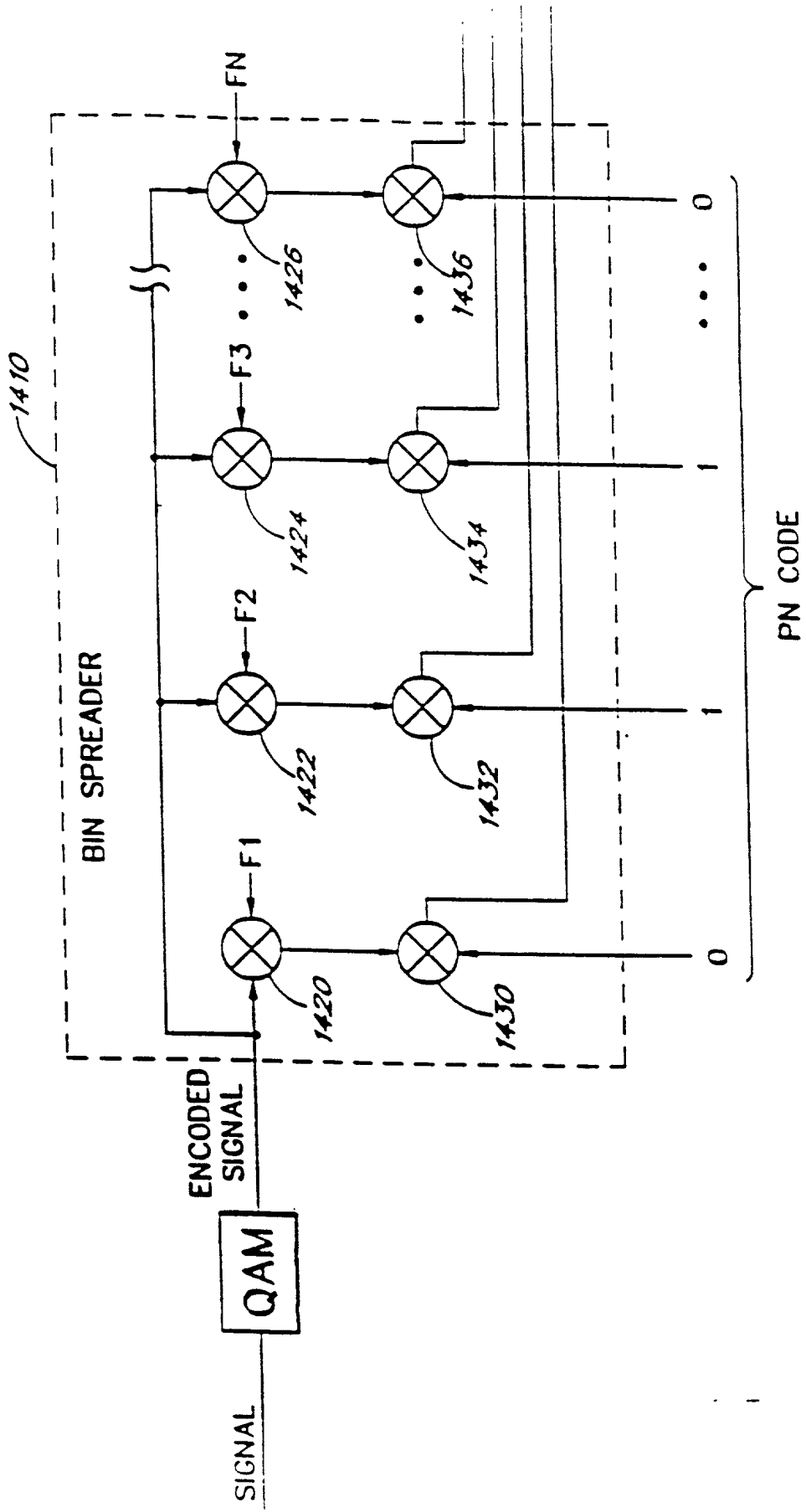


FIGURE 9

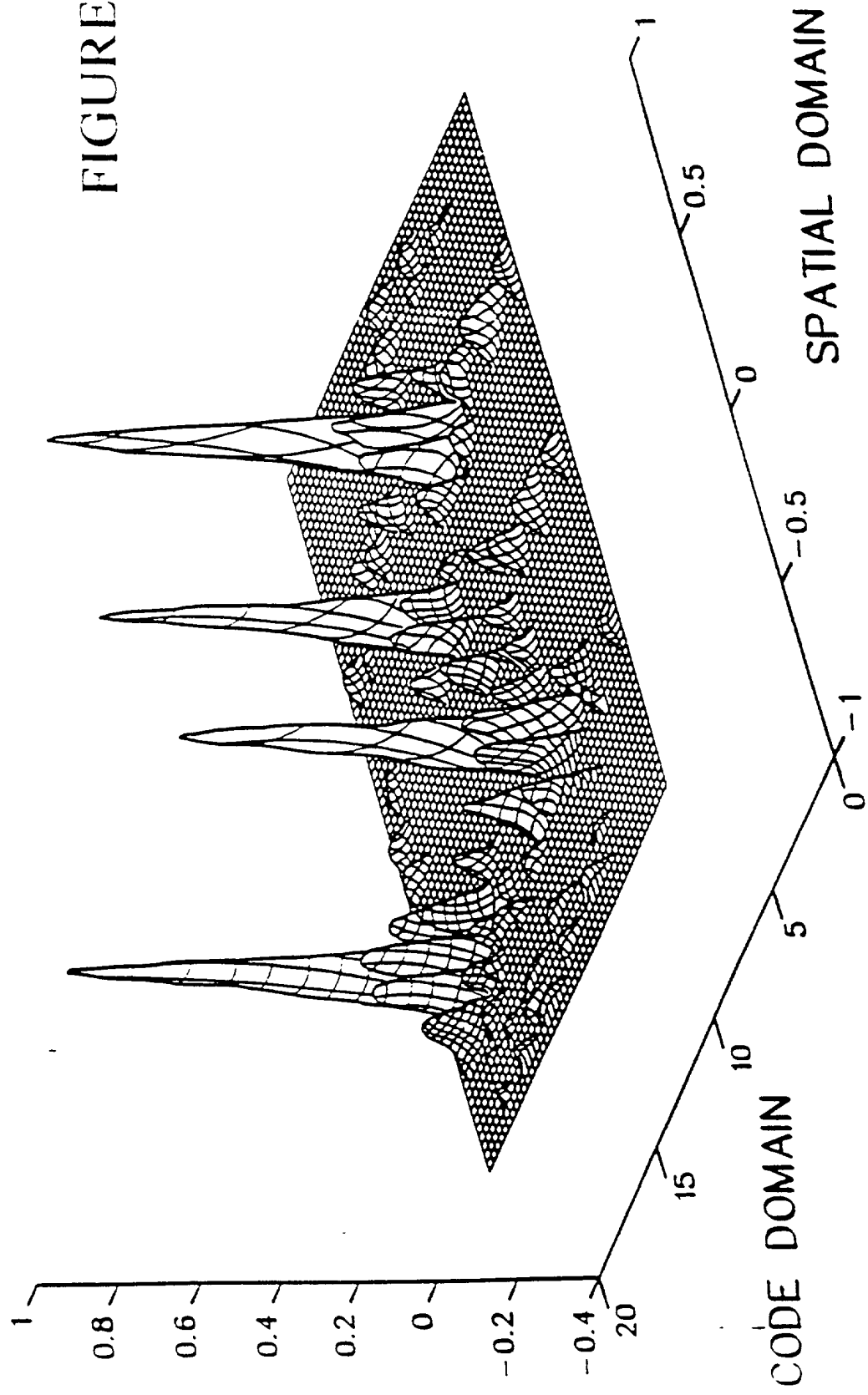


FIGURE 10

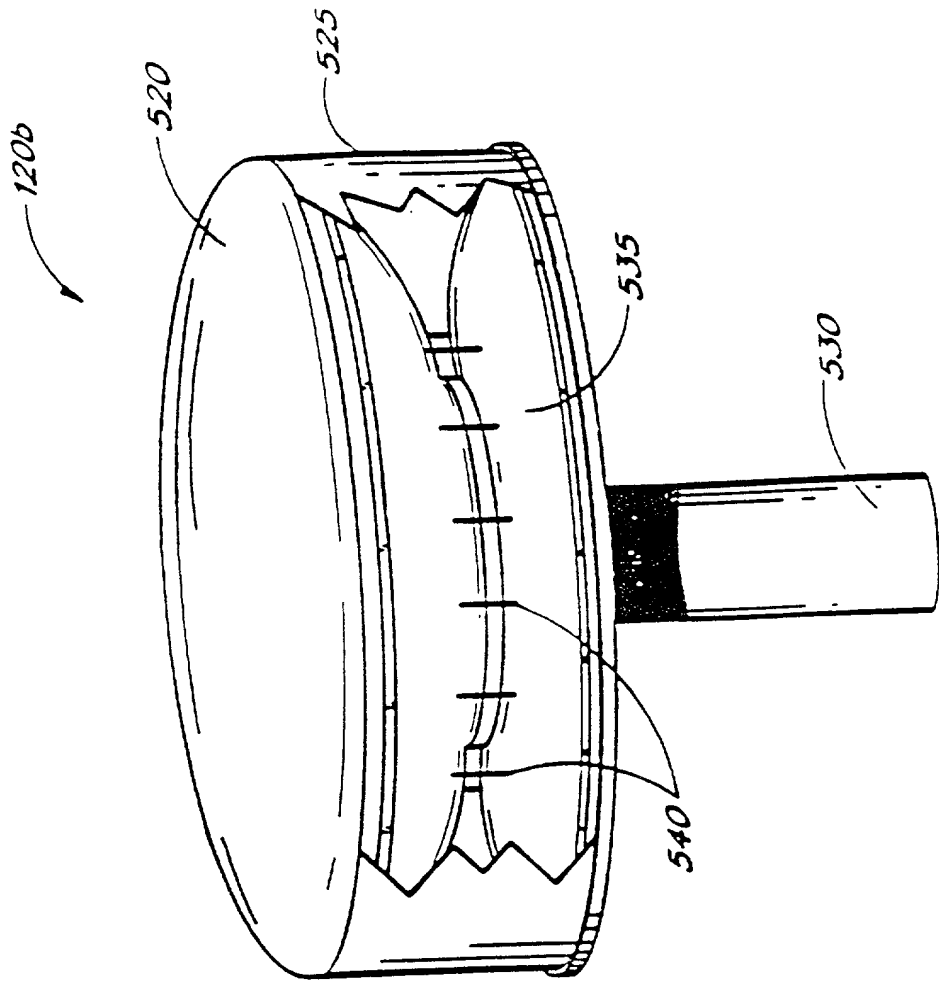


FIGURE 11

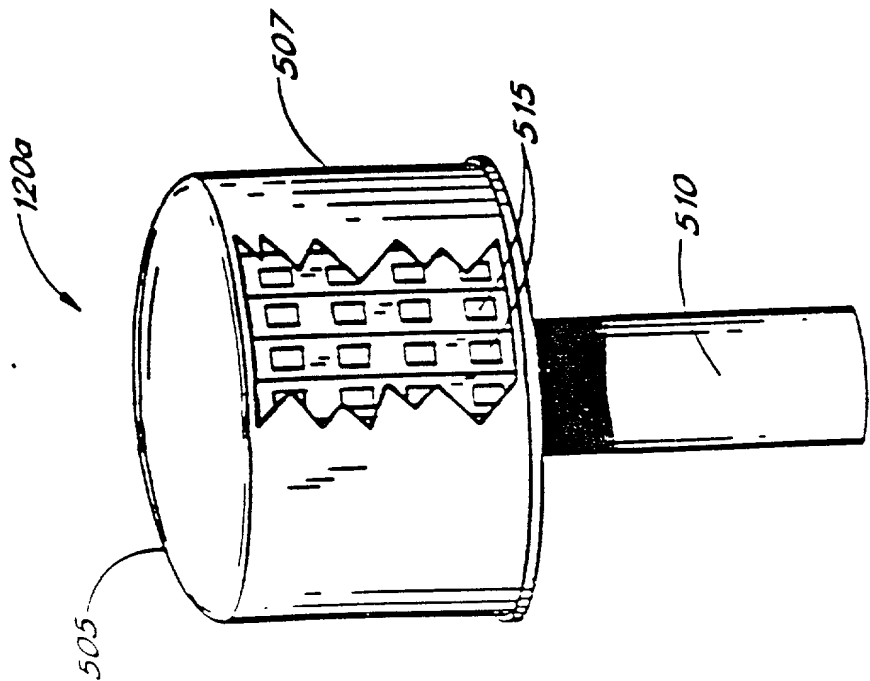


FIGURE 12

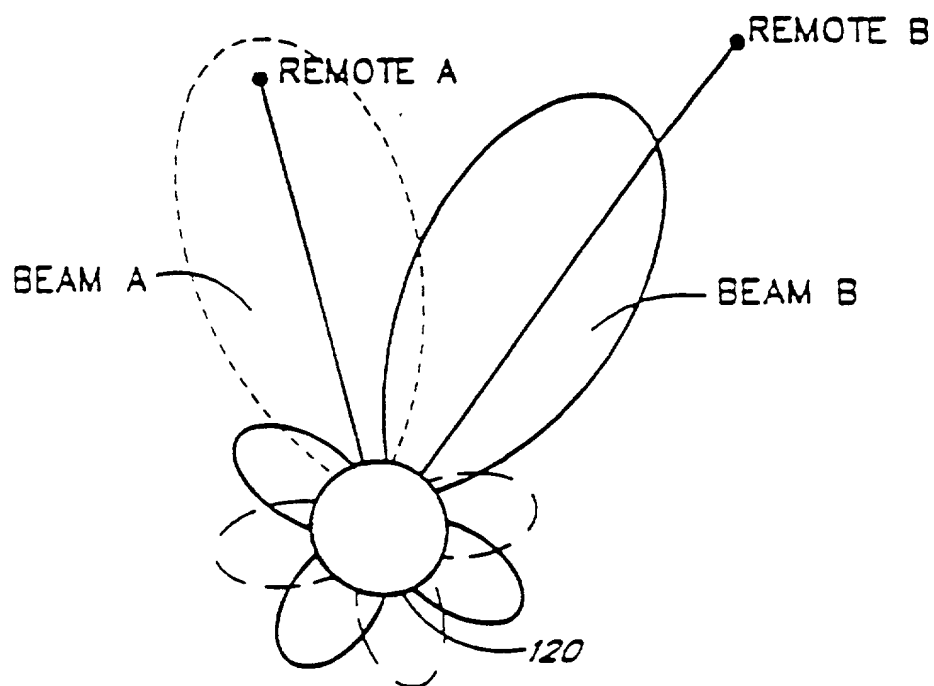


FIGURE 13

FIGURE 14

# Inverse Frequency-Channelized Spreader Implementation

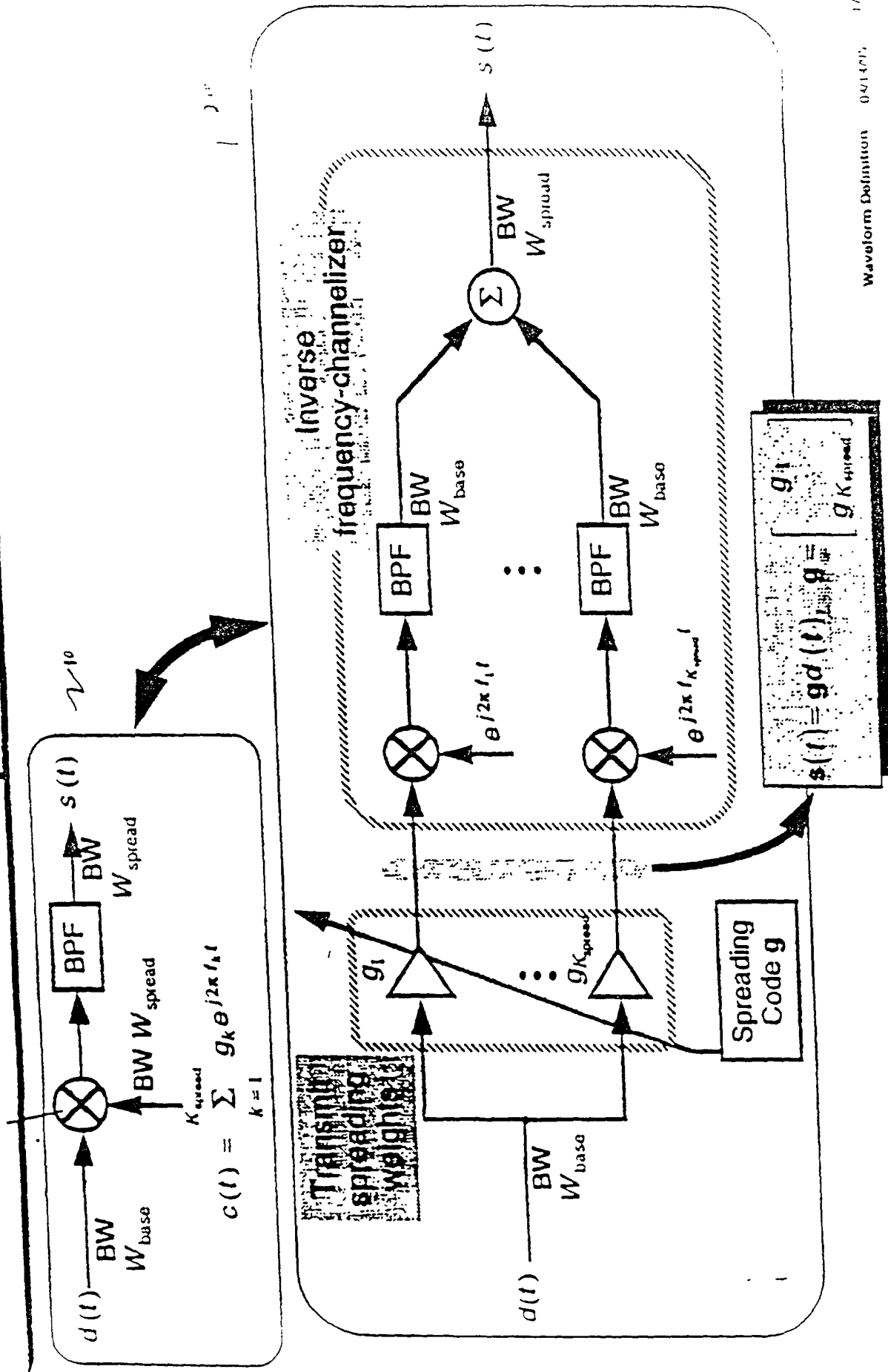
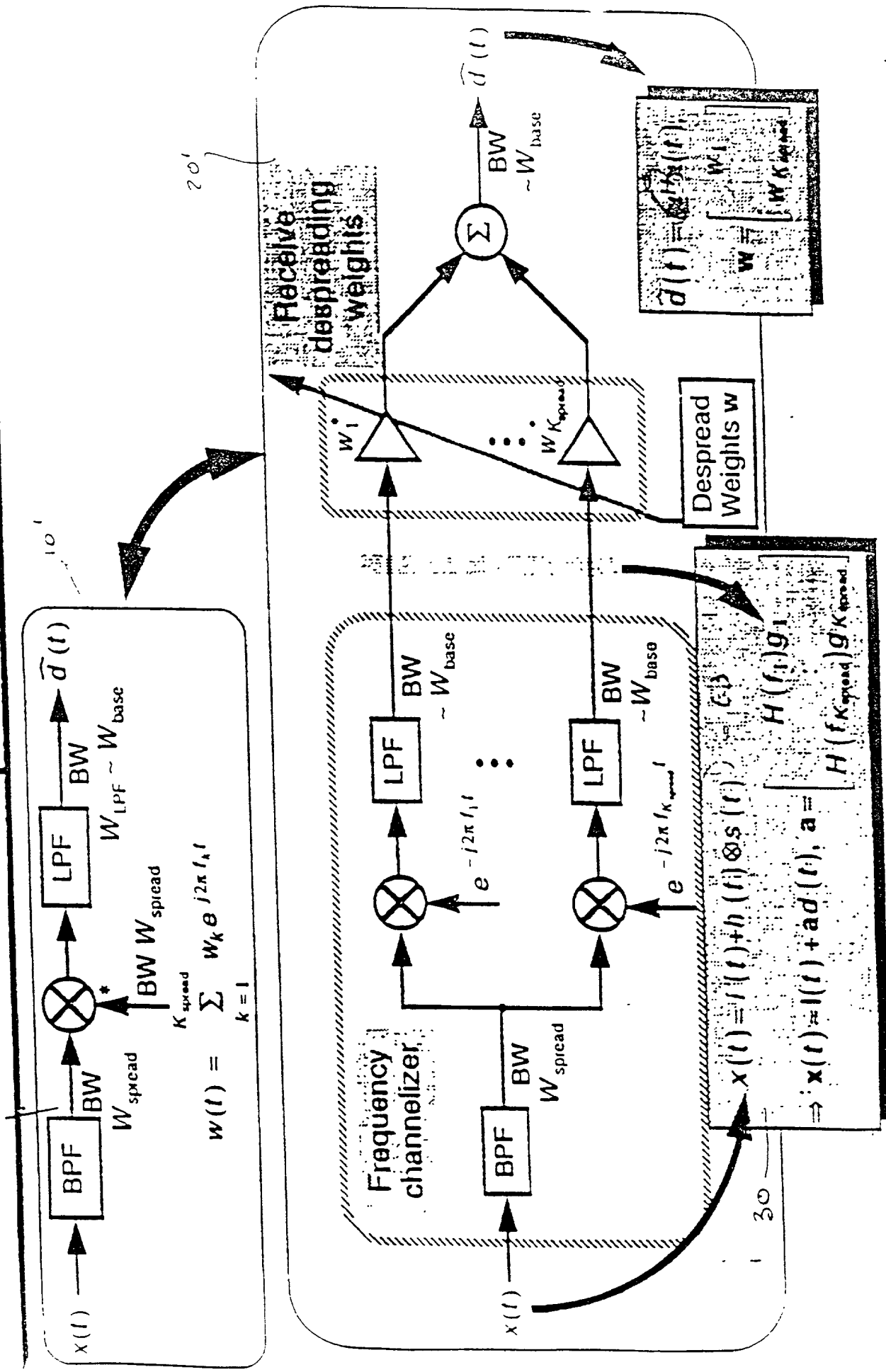


FIGURE 10

# Frequency-Channelized Despreader Implementation



The graph shows the magnitude of the transfer function  $|H(f)|$  in dB versus frequency  $f$  in degrees. The y-axis has labels at -70db, -85db, -90db, and -120db. The x-axis has labels at -180°, -90°, 0°, 90°, and 180°. A solid curve represents the theoretical magnitude response, which is symmetric about 0° and has minima at ±90°. A dashed horizontal line is drawn at -85db. Data points are plotted as open circles and crosses (+). Vertical dashed lines connect the minima of the curve to the x-axis at ±90°.

FIGURE 16

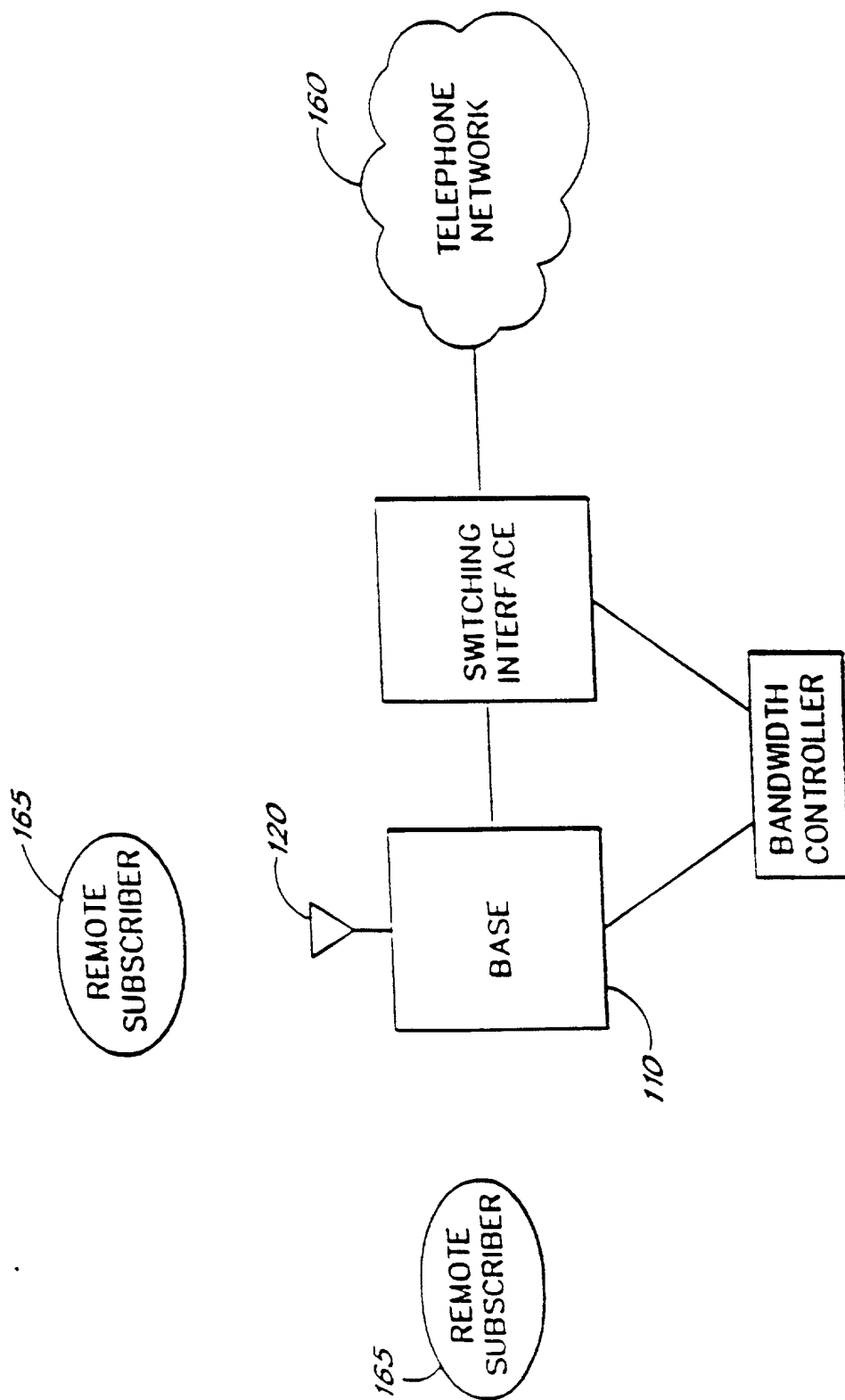


FIGURE 17

FORM 60602660

**FIG. 18** *Possible Operational Frequency Bands for PWAN*

Base frequency	Lower RF band	Upper RF band
1850 MHz	1850-1855 MHz	1930-1935 MHz
1855 MHz	1855-1860 MHz	1935-1940 MHz
1860 MHz	1860-1865 MHz	1940-1945 MHz
1865 MHz	1865-1870 MHz	1945-1950 MHz
1870 MHz	1870-1875 MHz	1950-1955 MHz
1875 MHz	1875-1880 MHz	1955-1960 MHz
1880 MHz	1880-1885 MHz	1960-1965 MHz
1885 MHz	1885-1890 MHz	1965-1970 MHz
1890 MHz	1890-1895 MHz	1970-1975 MHz
1895 MHz	1895-1900 MHz	1975-1980 MHz
1900 MHz	1900-1905 MHz	1980-1985 MHz
1905 MHz	1905-1910 MHz	1985-1990 MHz

FIG. 19

PWAN Airlink RF Band/Subband Organization

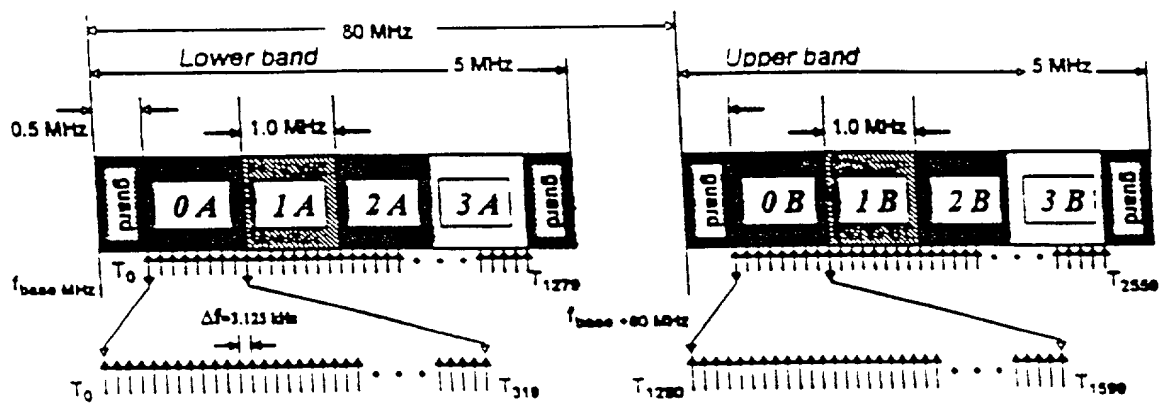


FIG. 20

Tones Within Each Subband

Subband pair designation		Tones
Subband pair 0	0 A	$\{T_0, T_1, \dots, T_{319}\}$
	0 B	$\{T_{1280}, T_{1281}, \dots, T_{1599}\}$
Subband pair 1	1 A	$\{T_{320}, T_{321}, \dots, T_{639}\}$
	1 B	$\{T_{1600}, T_{1601}, \dots, T_{1919}\}$
Subband pair 2	2 A	$\{T_{640}, T_{641}, \dots, T_{959}\}$
	2 B	$\{T_{1920}, T_{1921}, \dots, T_{2239}\}$
Subband pair 3	3 A	$\{T_{960}, T_{961}, \dots, T_{1279}\}$
	3 B	$\{T_{2240}, T_{2241}, \dots, T_{2559}\}$

FIG. 21 Traffic Partitions

Traffic tones = 32 Traffic partitions

1 Traffic partition = 72 Tones

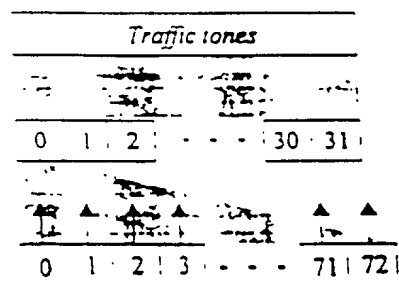


FIG. 22 Tone Mapping to the  $i$ th Traffic Partition

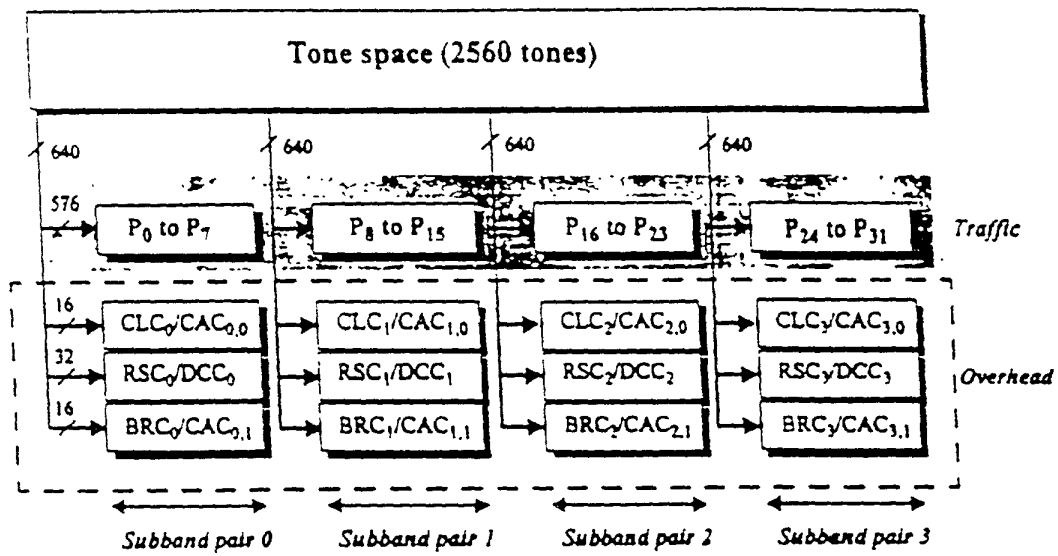
Tone Index	Tone	Tone Index	Tone	Tone Index	Tone	Tone Index	Tone
$P_i(0)$	$T_{20i+1}$	$P_i(18)$	$T_{20i+161}$	$P_i(36)$	$T_{20i+1281}$	$P_i(54)$	$T_{20i+1441}$
$P_i(1)$	$T_{20i+2}$	$P_i(19)$	$T_{20i+162}$	$P_i(37)$	$T_{20i+1282}$	$P_i(55)$	$T_{20i+1442}$
$P_i(2)$	$T_{20i+3}$	$P_i(20)$	$T_{20i+163}$	$P_i(38)$	$T_{20i+1283}$	$P_i(56)$	$T_{20i+1443}$
$P_i(3)$	$T_{20i+4}$	$P_i(21)$	$T_{20i+164}$	$P_i(39)$	$T_{20i+1284}$	$P_i(57)$	$T_{20i+1444}$
$P_i(4)$	$T_{20i+5}$	$P_i(22)$	$T_{20i+165}$	$P_i(40)$	$T_{20i+1285}$	$P_i(58)$	$T_{20i+1445}$
$P_i(5)$	$T_{20i+6}$	$P_i(23)$	$T_{20i+166}$	$P_i(41)$	$T_{20i+1286}$	$P_i(59)$	$T_{20i+1446}$
$P_i(6)$	$T_{20i+7}$	$P_i(24)$	$T_{20i+167}$	$P_i(42)$	$T_{20i+1287}$	$P_i(60)$	$T_{20i+1447}$
$P_i(7)$	$T_{20i+8}$	$P_i(25)$	$T_{20i+168}$	$P_i(43)$	$T_{20i+1288}$	$P_i(61)$	$T_{20i+1448}$
$P_i(8)$	$T_{20i+9}$	$P_i(26)$	$T_{20i+169}$	$P_i(44)$	$T_{20i+1289}$	$P_i(62)$	$T_{20i+1449}$
$P_i(9)$	$T_{20i+11}$	$P_i(27)$	$T_{20i+171}$	$P_i(45)$	$T_{20i+1291}$	$P_i(63)$	$T_{20i+1451}$
$P_i(10)$	$T_{20i+12}$	$P_i(28)$	$T_{20i+172}$	$P_i(46)$	$T_{20i+1292}$	$P_i(64)$	$T_{20i+1452}$
$P_i(11)$	$T_{20i+13}$	$P_i(29)$	$T_{20i+173}$	$P_i(47)$	$T_{20i+1293}$	$P_i(65)$	$T_{20i+1453}$
$P_i(12)$	$T_{20i+14}$	$P_i(30)$	$T_{20i+174}$	$P_i(48)$	$T_{20i+1294}$	$P_i(66)$	$T_{20i+1454}$
$P_i(13)$	$T_{20i+15}$	$P_i(31)$	$T_{20i+175}$	$P_i(49)$	$T_{20i+1295}$	$P_i(67)$	$T_{20i+1455}$
$P_i(14)$	$T_{20i+16}$	$P_i(32)$	$T_{20i+176}$	$P_i(50)$	$T_{20i+1296}$	$P_i(68)$	$T_{20i+1456}$
$P_i(15)$	$T_{20i+17}$	$P_i(33)$	$T_{20i+177}$	$P_i(51)$	$T_{20i+1297}$	$P_i(69)$	$T_{20i+1457}$
$P_i(16)$	$T_{20i+18}$	$P_i(34)$	$T_{20i+178}$	$P_i(52)$	$T_{20i+1298}$	$P_i(70)$	$T_{20i+1458}$
$P_i(17)$	$T_{20i+19}$	$P_i(35)$	$T_{20i+179}$	$P_i(53)$	$T_{20i+1299}$	$P_i(71)$	$T_{20i+1459}$

**FIG. 23** *Overhead Tone Mapping to Channels for the  $i$ th Subband Pair*

Tones allocated to CLC/CAC in subband pair $i$ (CLC/CAC <sub><math>i,0</math></sub> )							
index	tone	index	tone	index	tone	index	tone
0	$T_{320i}$	1	$T_{320i+20}$	2	$T_{320i+40}$	3	$T_{320i+60}$
4	$T_{320i+160}$	5	$T_{320i+180}$	6	$T_{320i+200}$	7	$T_{320i+220}$
8	$T_{320i+1280}$	9	$T_{320i+1300}$	10	$T_{320i+1320}$	11	$T_{320i+1340}$
12	$T_{320i+1440}$	13	$T_{320i+1460}$	14	$T_{320i+1480}$	15	$T_{320i+1500}$
Tones allocated to BRC/CAC in subband pair $i$ (BRC/CAC <sub><math>i,1</math></sub> )							
index	tone	index	tone	index	tone	index	tone
0	$T_{320i+90}$	1	$T_{320i+110}$	2	$T_{320i+130}$	3	$T_{320i+150}$
4	$T_{320i+250}$	5	$T_{320i+270}$	6	$T_{320i+290}$	7	$T_{320i+310}$
8	$T_{320i+1370}$	9	$T_{320i+1390}$	10	$T_{320i+1410}$	11	$T_{320i+1430}$
12	$T_{320i+1530}$	13	$T_{320i+1550}$	14	$T_{320i+1570}$	15	$T_{320i+1590}$
Tones allocated to RSC/DCC in subband pair $i$ (RSC/DCC <sub><math>i</math></sub> )							
index	tone	index	tone	index	tone	index	tone
0	$T_{320i+10}$	1	$T_{320i+30}$	2	$T_{320i+50}$	3	$T_{320i+70}$
4	$T_{320i+80}$	5	$T_{320i+100}$	6	$T_{320i+120}$	7	$T_{320i+140}$
8	$T_{320i+170}$	9	$T_{320i+190}$	10	$T_{320i+210}$	11	$T_{320i+230}$
12	$T_{320i+240}$	13	$T_{320i+260}$	14	$T_{320i+280}$	15	$T_{320i+300}$
16	$T_{320i+1290}$	17	$T_{320i+1310}$	18	$T_{320i+1330}$	19	$T_{320i+1350}$
20	$T_{320i+1360}$	21	$T_{320i+1380}$	22	$T_{320i+1400}$	23	$T_{320i+1420}$
24	$T_{320i+1450}$	25	$T_{320i+1470}$	26	$T_{320i+1490}$	27	$T_{320i+1510}$
28	$T_{320i+1520}$	29	$T_{320i+1540}$	30	$T_{320i+1560}$	31	$T_{320i+1580}$

T06090" E0602660

**FIG. 24** *Division of Tone Space to Traffic and Overhead Tones*



**FIG. 25** Time Division Duplex for Base and RU Transmissions

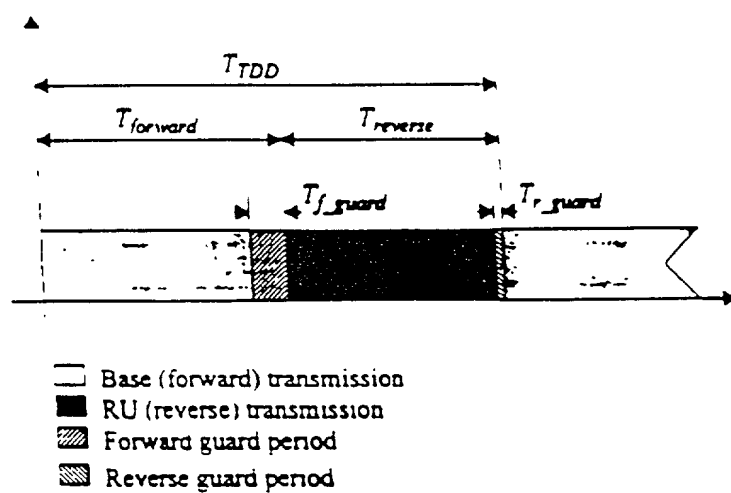


FIG. 26 Details of Forward and Reverse Channel Time Parameters

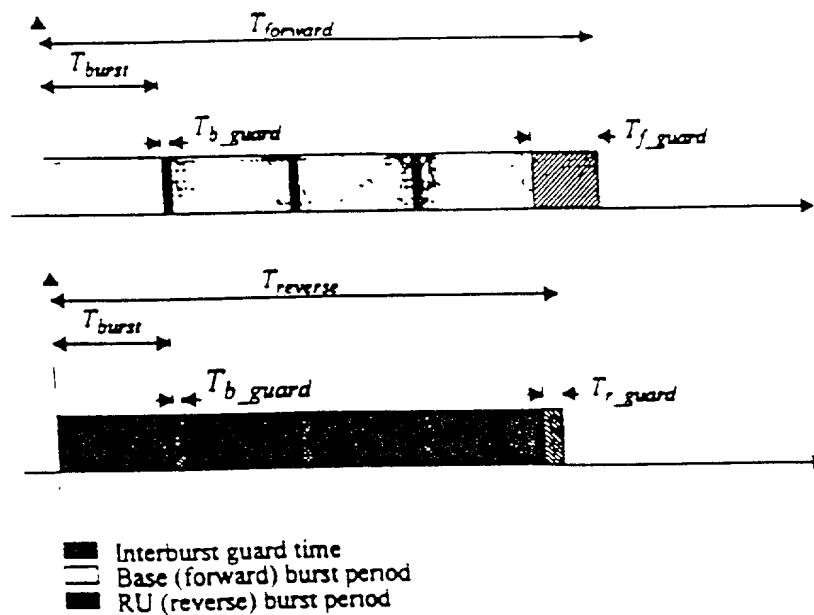
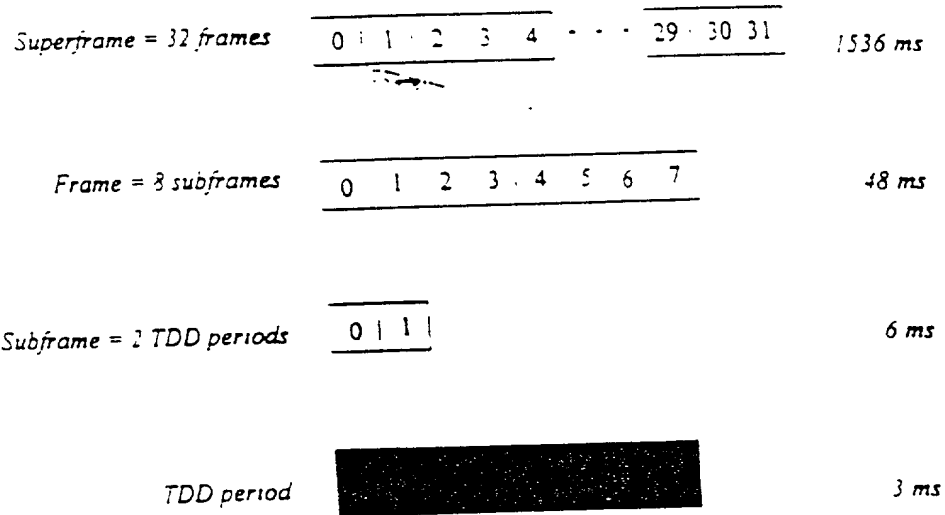
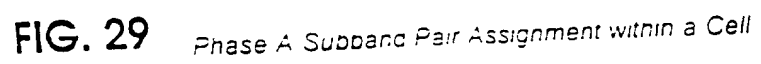


FIG. 27 TDD Parameter Values

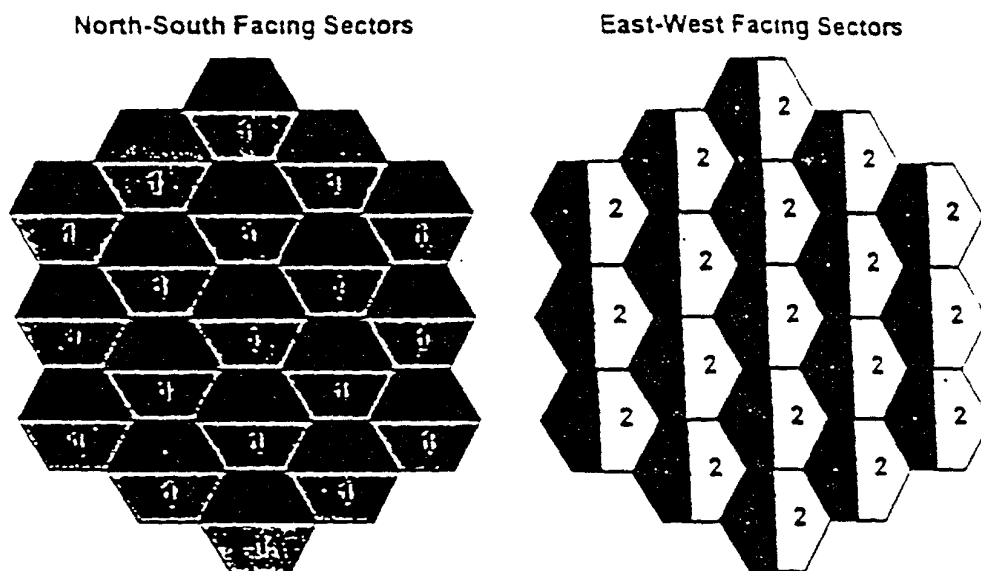
TDD parameter	Value ( $\mu$ s)
$T_{\text{forward}}$	1610
$T_{\text{reverse}}$	1390
$T_{\text{f\_guard}}$	255
$T_{\text{r\_guard}}$	35
$T_{\text{revisit}}$	3000
$T_{\text{burst}}$	320
$T_{\text{b\_guard}}$	25

**FIG. 28**      *Physical Layer Framing Structure*

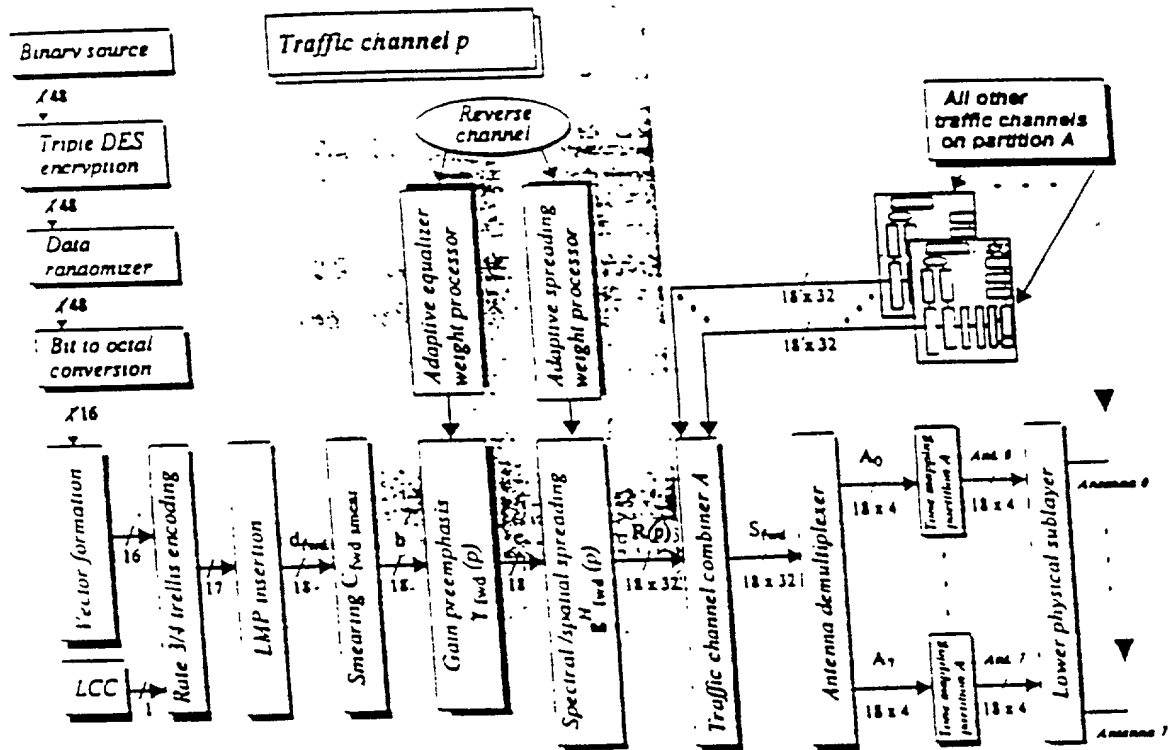




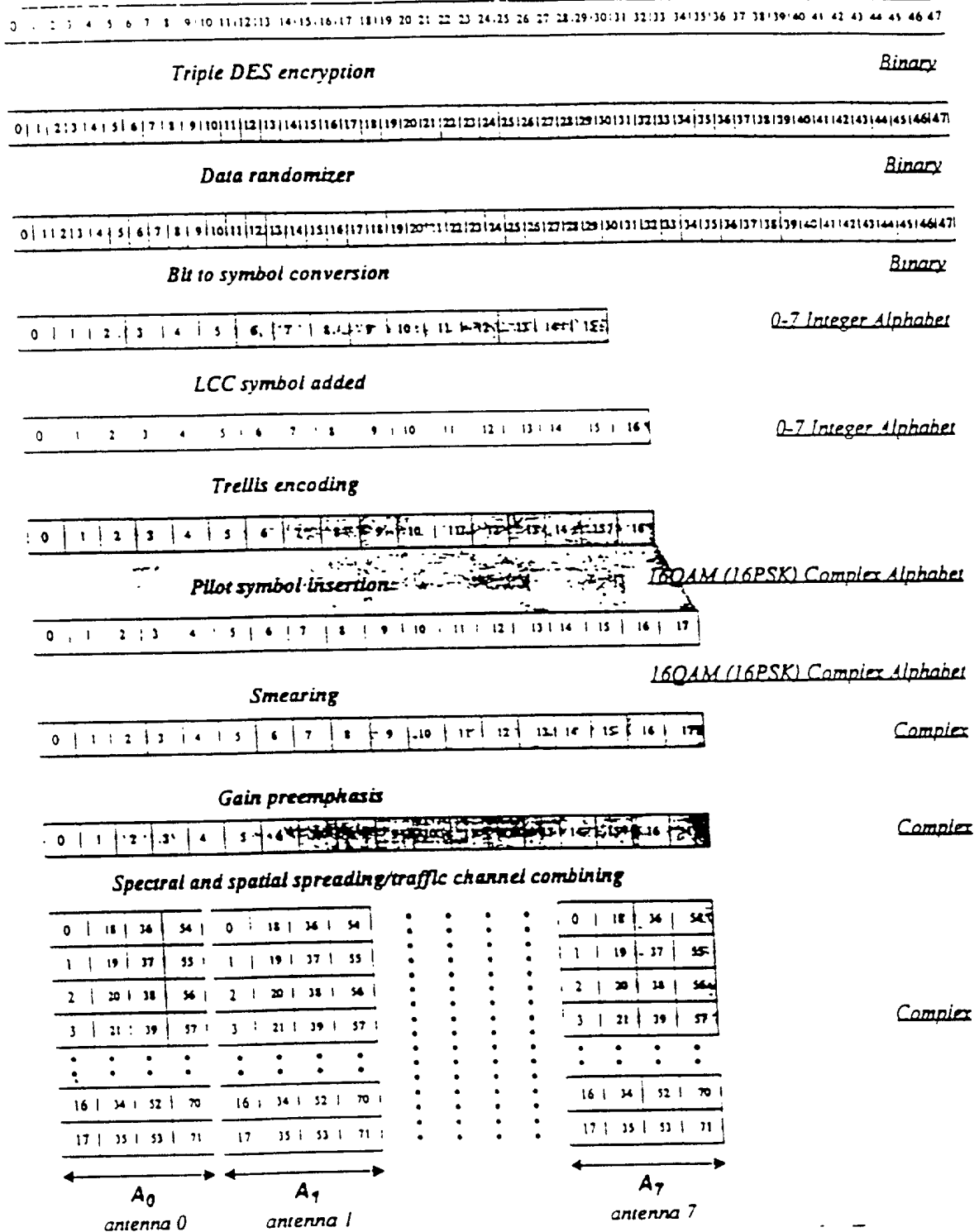
**FIG. 30** *Phase-A Subband Pair Assignment across Cells*



**FIG. 31** Functional Block Diagram - Upper Physical Layer of Base Transmitter for High Capacity Mode



**FIG. 32** Data Transformation Diagram - High Capacity Forward Channel Transmissions



**FIG. 33** Functional Block Diagram - Upper Physical Layer of Base Transmitter for Medium Capacity Mode

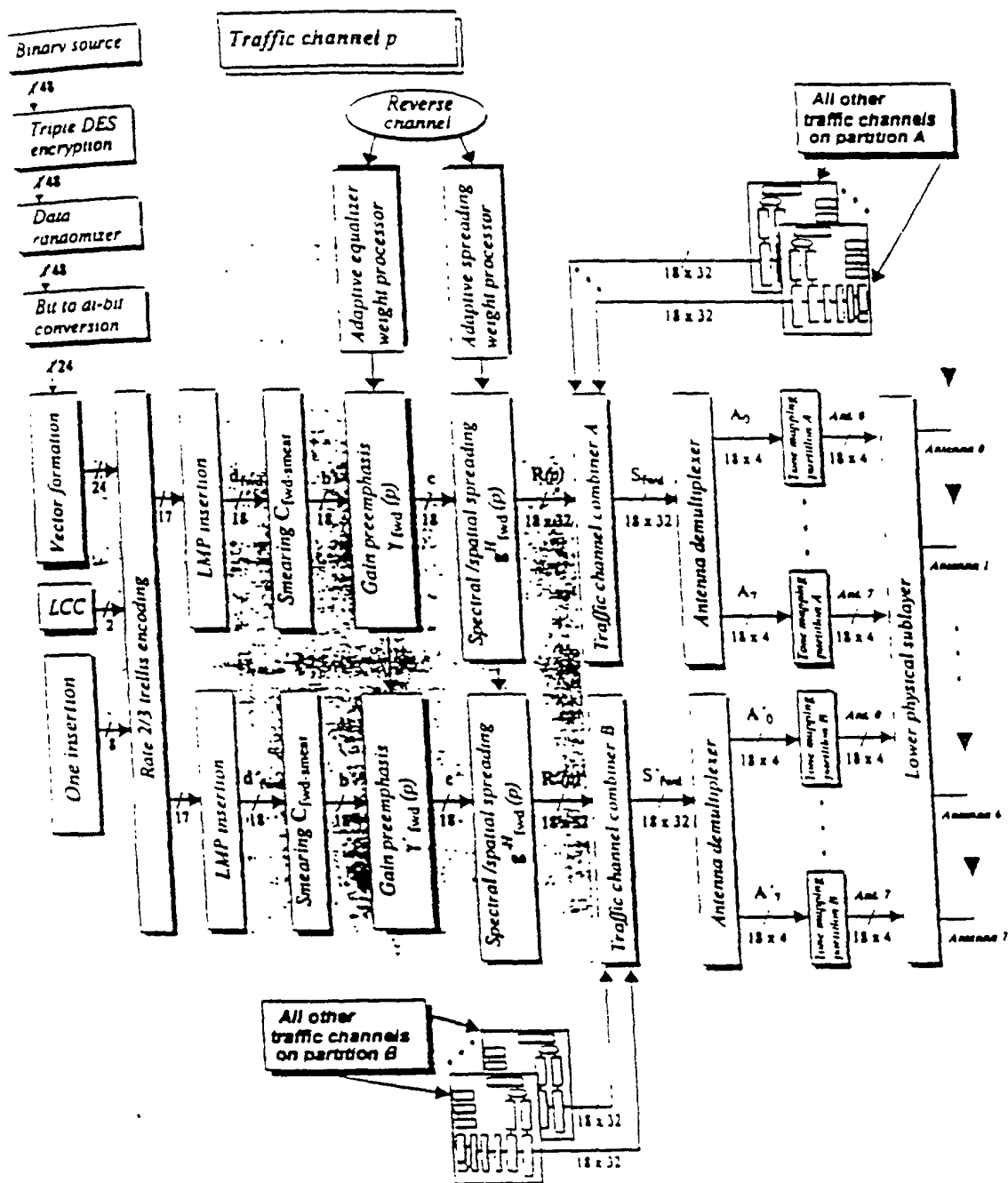
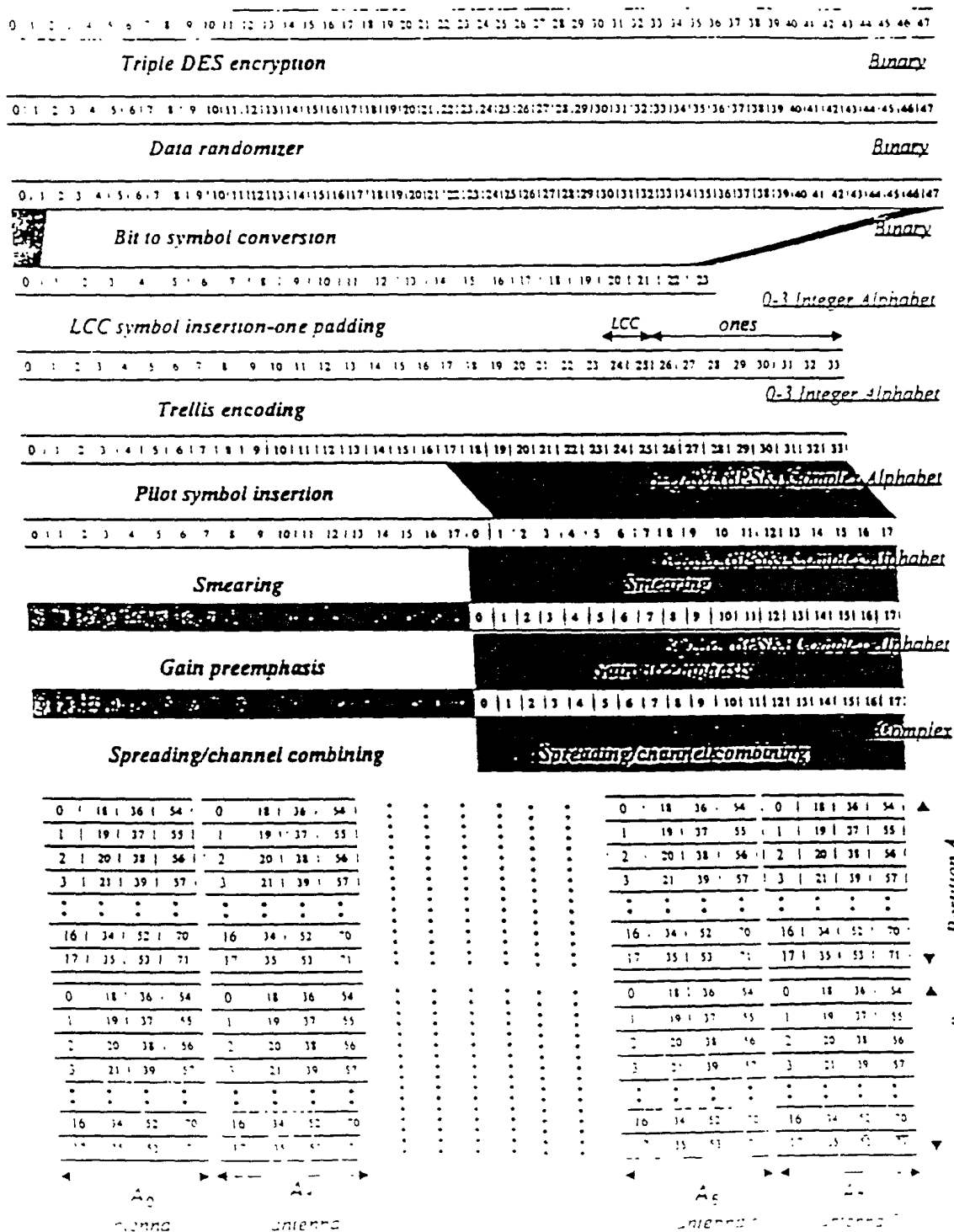


FIG. 34

Data Transformation Diagram - Medium Capacity Forward Channel Transmissions



Functional Block Diagram - Upper Physical Layer of Base Transmitter for Low Capacity Mode

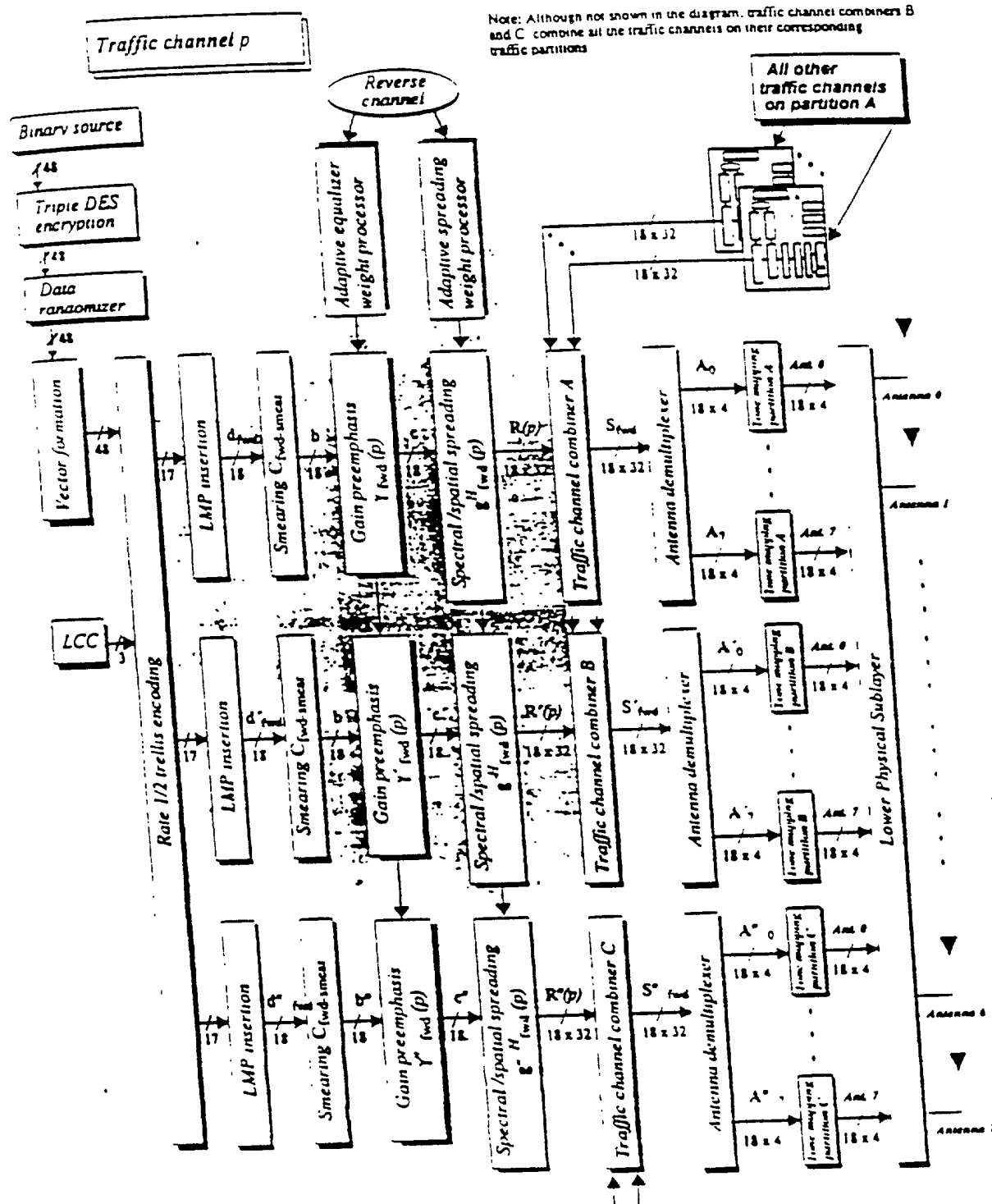


FIG. 36

**FIG. 36** Data Transformation Diagram - Low Capacity Forward Channel Transmissions

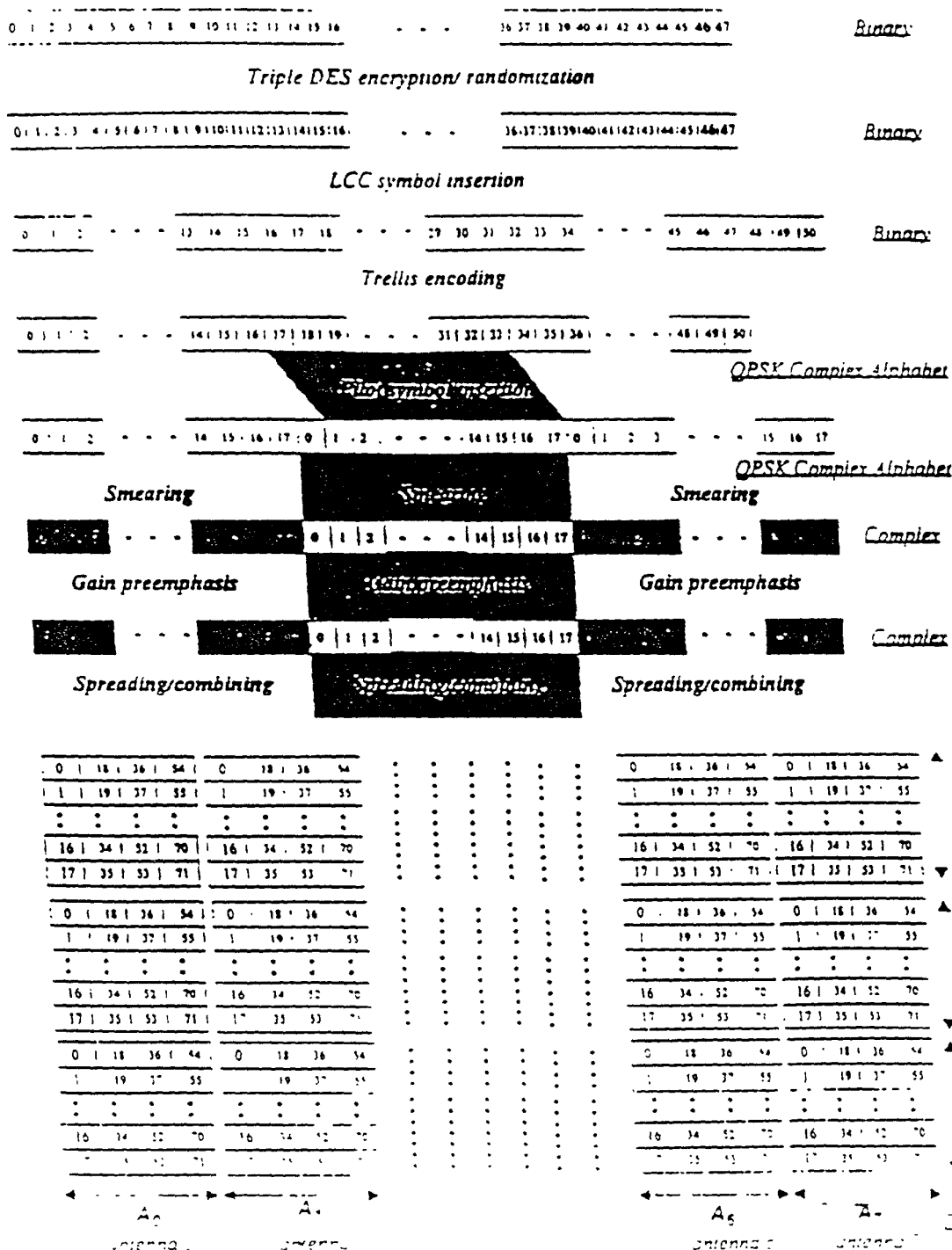
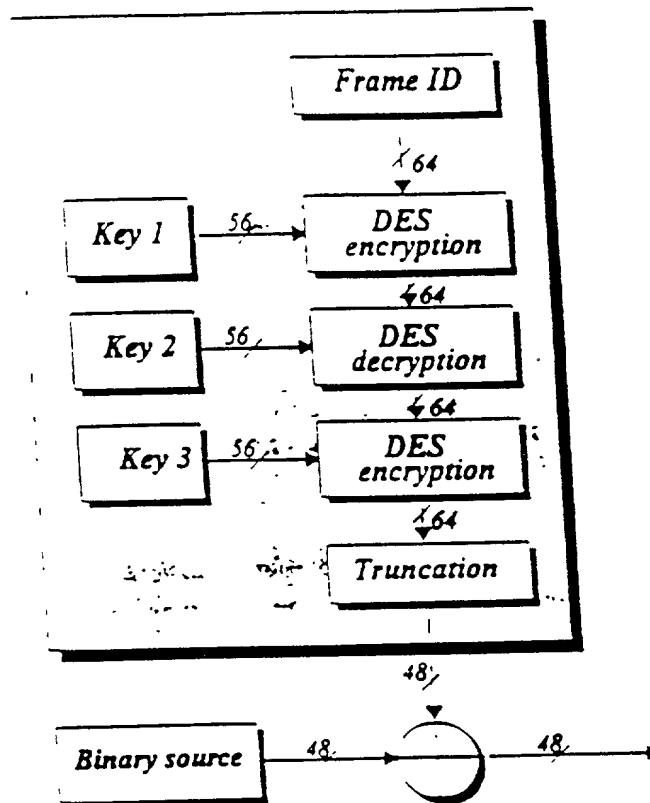
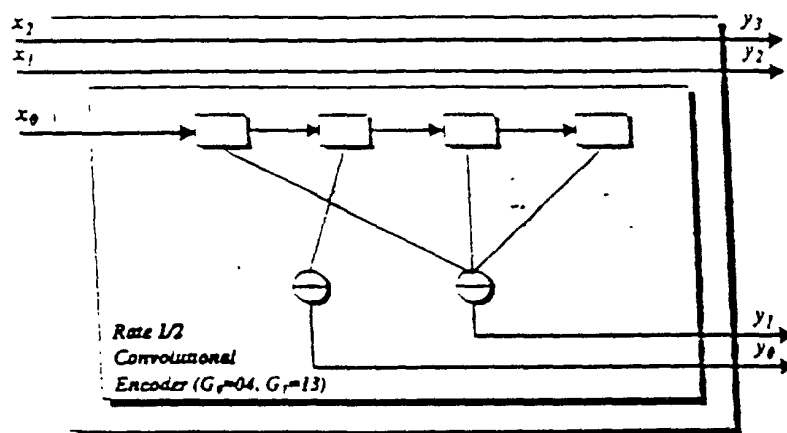


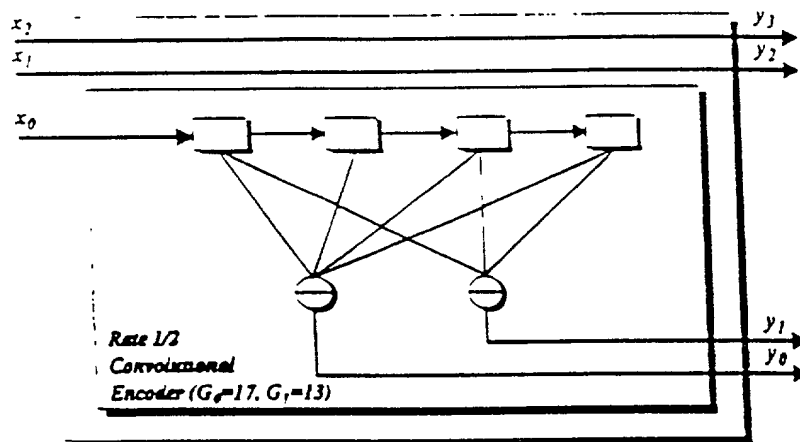
FIG. 37 Triple DES Encryption Algorithm



**FIG. 38** Feed Forward Shift Register Implementation of Rate 3/4, 16PSK Trellis Encoder for High Capacity Mode



**FIG. 39** Feed Forward Shift Register Implementation of Rate 3/4, 16QAM Trellis Encoder for High Capacity Mode



**FIG. 40** Signal Mappings for Rate 3/4, 16QAM and 16PSK Trellis Encoding Schemes Employed in High Capacity Mode

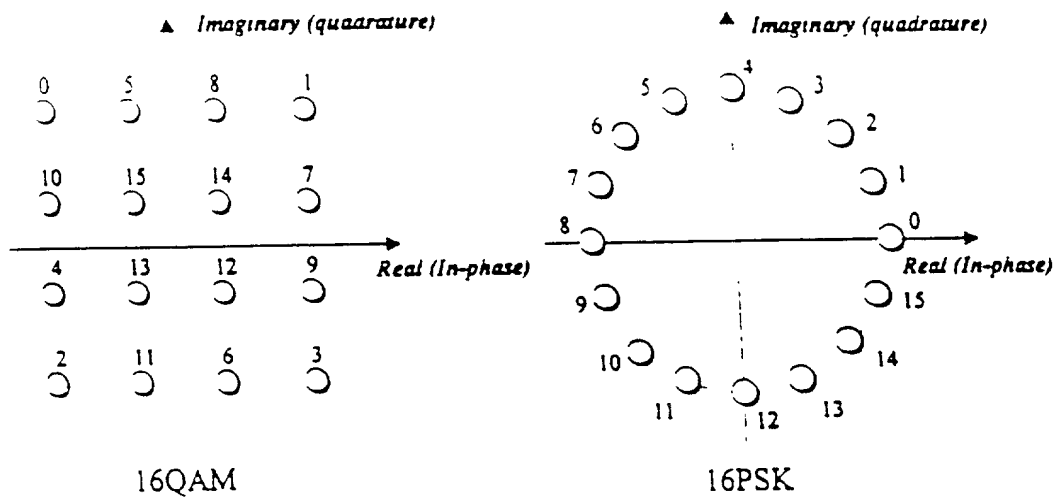
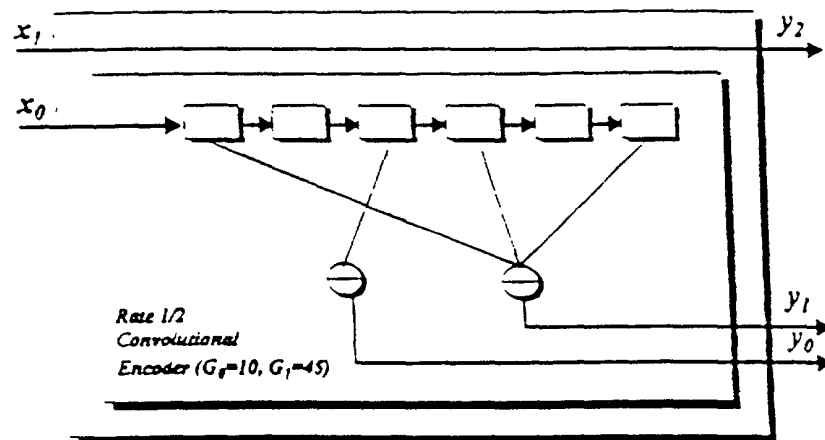


FIG. 41

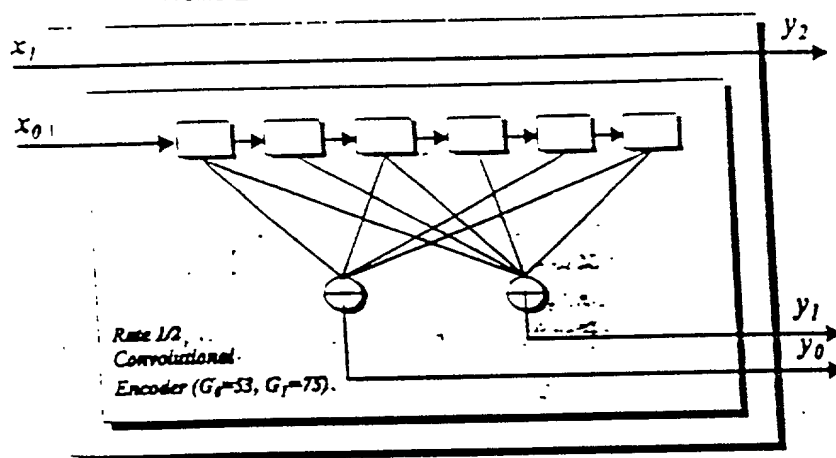
Signal Mappings for Rate 3/4, Pragmatic 16QAM and 16PSK  
Trellis Encoding Schemes Employed in High Capacity Mode

Output symbol	Output bits				Signal mapping (16QAM)		Signal mapping (16PSK)	
	$y_3$	$y_2$	$y_1$	$y_0$	In phase	Quadrature	In phase	Quadrature
0	0	0	0	0	$-3/\sqrt{10}$	$3/\sqrt{10}$	1.0	0.0
1	0	0	0	1	$3/\sqrt{10}$	$3/\sqrt{10}$	0.924	0.383
2	0	0	1	0	$-3/\sqrt{10}$	$-3/\sqrt{10}$	0.707	0.707
3	0	0	1	1	$3/\sqrt{10}$	$-3/\sqrt{10}$	0.383	0.924
4	0	1	0	0	$-3/\sqrt{10}$	$-1/\sqrt{10}$	0	1
5	0	1	0	1	$-1/\sqrt{10}$	$3/\sqrt{10}$	-0.383	0.924
6	0	1	1	0	$1/\sqrt{10}$	$-3/\sqrt{10}$	-0.707	0.707
7	0	1	1	1	$3/\sqrt{10}$	$1/\sqrt{10}$	-0.924	0.383
8	1	0	0	0	$1/\sqrt{10}$	$3/\sqrt{10}$	-1.0	0.0
9	1	0	0	1	$3/\sqrt{10}$	$-1/\sqrt{10}$	-0.924	-0.383
10	1	0	1	0	$-3/\sqrt{10}$	$1/\sqrt{10}$	-0.707	-0.707
11	1	0	1	1	$-1/\sqrt{10}$	$-3/\sqrt{10}$	-0.383	-0.924
12	1	1	0	0	$1/\sqrt{10}$	$-1/\sqrt{10}$	0	-1
13	1	1	0	1	$-1/\sqrt{10}$	$-1/\sqrt{10}$	0.383	-0.924
14	1	1	1	0	$1/\sqrt{10}$	$1/\sqrt{10}$	0.707	-0.707
15	1	1	1	1	$-1/\sqrt{10}$	$1/\sqrt{10}$	0.924	-0.383

**FIG. 42** *Feed Forward Shift Register Implementation of Rate 2/3, 8PSK Trellis Encoder for Medium Capacity Mode*



**FIG. 43** Feed Forward Shift Register Implementation of Rate 2/3, 8QAM Trellis Encoder for Medium Capacity Mode



**FIG. 44** Signal Mappings for Rate 2/3, 8QAM and 8PSK Trellis Encoding Schemes Employed in Medium Capacity Mode

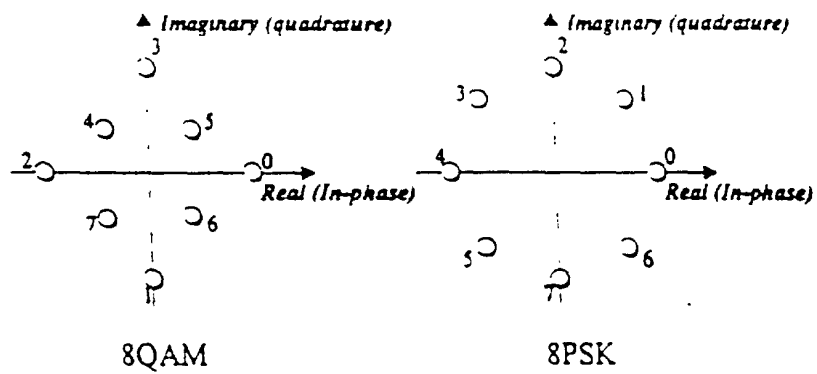
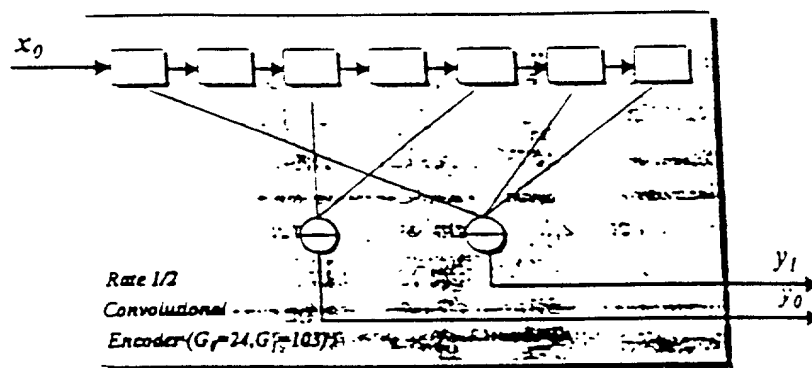


FIG. 45

**FIG. 45** *Signal Mappings for Rate 2/3, 8QAM and 8PSK Trellis Encoding Schemes Employed in Medium Capacity Mode*

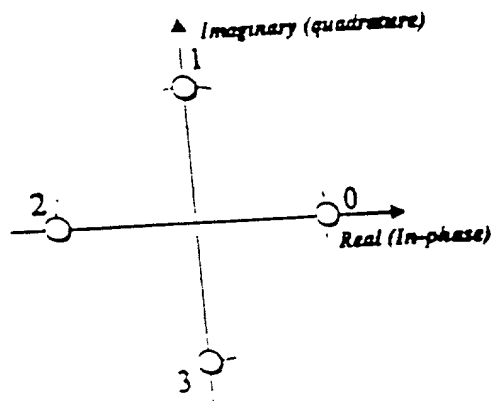
Output symbol	Output bits			Signal mapping (8QAM)		Signal mapping (8PSK)	
	Y <sub>2</sub>	Y <sub>1</sub>	Y <sub>0</sub>	In phase	Quadrature	In phase	Quadrature
0	0	0	0	1.21	0	1	0
1	0	0	1	0	-1.21	$1/\sqrt{2}$	$1/\sqrt{2}$
2	0	1	0	-1.21	0	0	1
3	0	1	1	0	1.21	$-1/\sqrt{2}$	$1/\sqrt{2}$
4	1	0	0	-0.518	0.518	-1	0
5	1	0	1	0.518	0.518	$-1/\sqrt{2}$	$-1/\sqrt{2}$
6	1	1	0	0.518	-0.518	0	-1
7	1	1	1	-0.518	-0.518	$1/\sqrt{2}$	$-1/\sqrt{2}$

**FIG. 46** Feed Forward Shift Register Implementation of Rate 1/2 Convolutional Encoder for Low Capacity Mode



03920903 0001  
T06000 E0602660

**FIG. 47** Signal Mapping for Rate 1/2, QPSK Pragmatic Trellis Encoding Scheme Employed in Low Capacity Mode



**FIG. 48** *Gray-Coded Mapping for Rate 1/2, QPSK Pragmatic Trellis Encoding Scheme Employed in Low Capacity Mode*

Output symbol	Output bits		Signal mapping	
	$y_1$	$y_0$	In phase	Quadrature
0	0	0	1	0
1	0	1	0	1
2	1	0	-1	0
3	1	1	0	-1

**FIG. 49** Base Mapping of Elements of Received Weight Vector to Antenna Elements and Tones

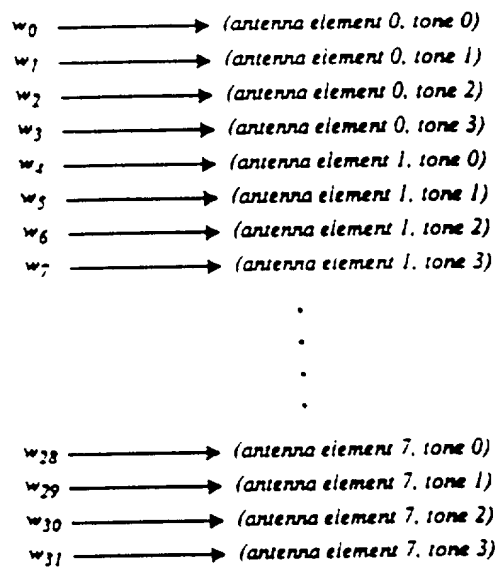
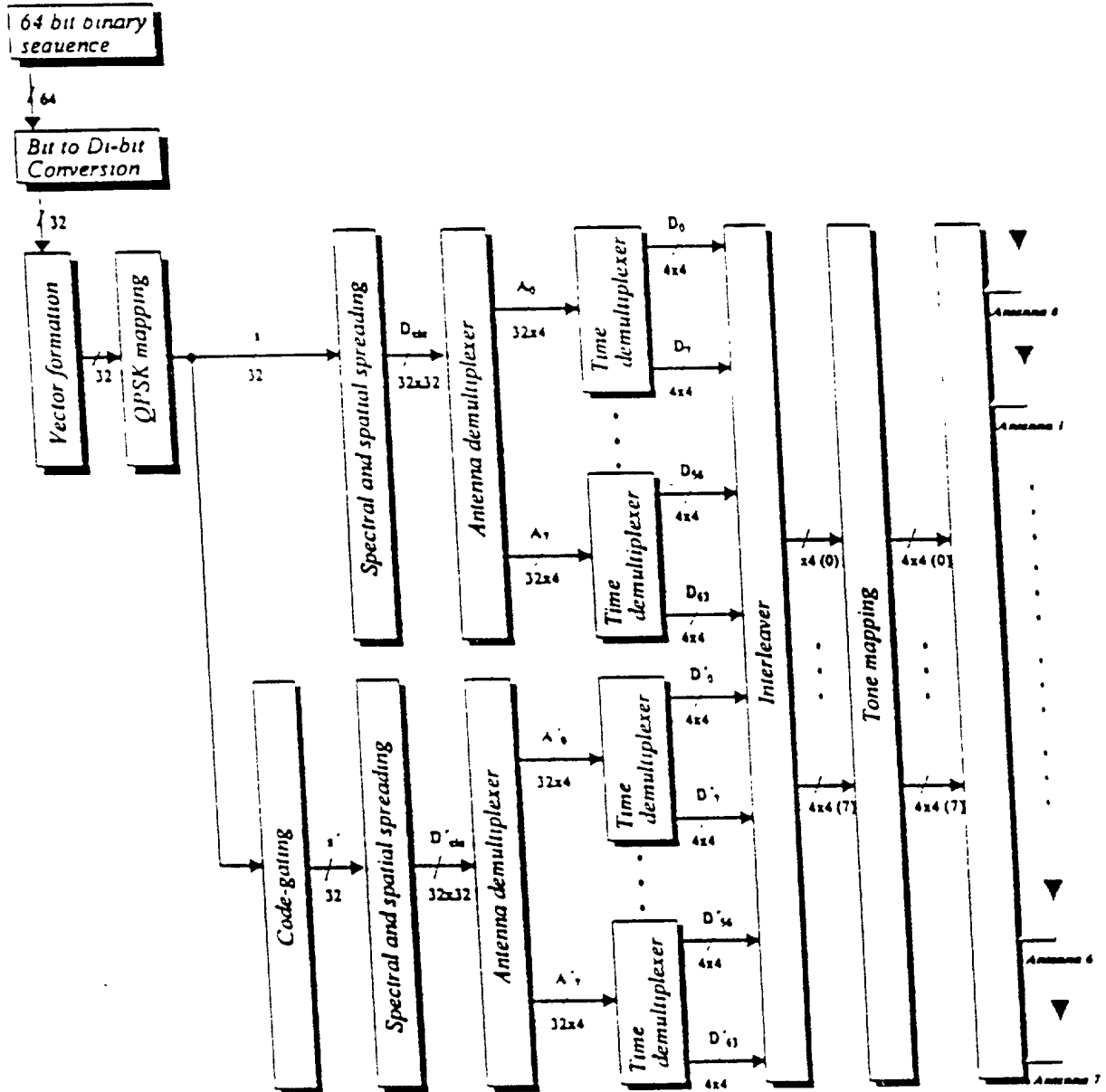
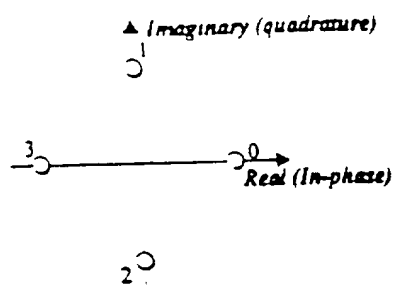


FIG. 50

Block Diagram Representation of CLC Physical Layer Format



**FIG. 51** QPSK Signal Mapping for the CLC Channel



**FIG. 51'** *QPSK Signal Mapping for the CLC Channel*

Symbol	Signal mapping	
	In phase	Quadrature
0	1	0
1	0	1
2	0	-1
3	-1	0

**FIG. 52**      *The CLC Interleaving Rule*

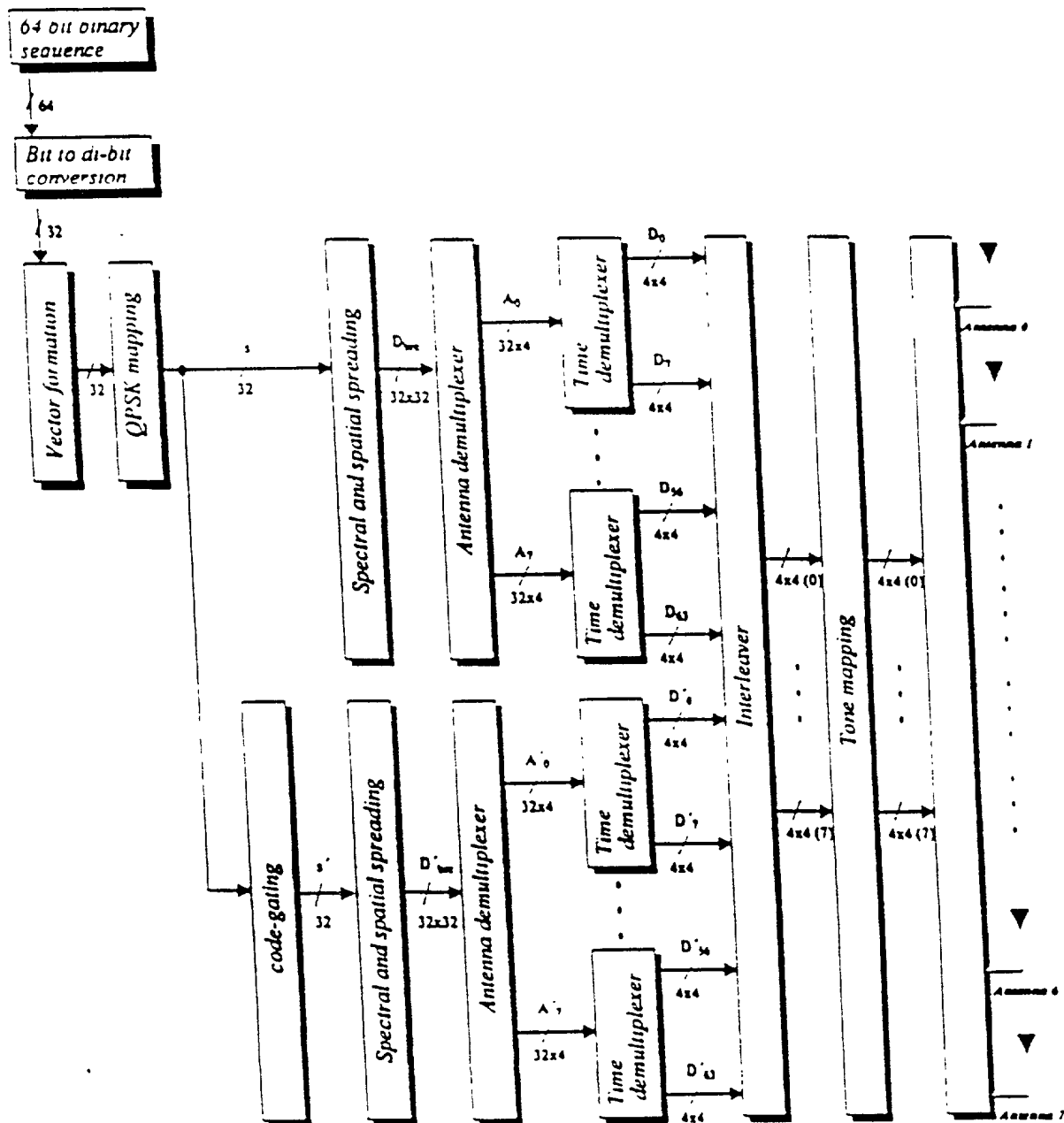
Antenna	Burst number															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	$D_0$	$D_1$	$D_7$	$D_7$	$D_4$	$D_5$	$D_6$	$D_7$	$D_8$	$D_9$	$D_{10}$	$D_{11}$	$D_{12}$	$D_{13}$	$D_{14}$	$D_{15}$
1	$D_0$	$D_6$	$D_{10}$	$D_{11}$	$D_{12}$	$D_{13}$	$D_{14}$	$D_{15}$	$D_{16}$	$D_{17}$	$D_{18}$	$D_{19}$	$D_{20}$	$D_{21}$	$D_{22}$	$D_{23}$
2	$D_{16}$	$D_{17}$	$D_{18}$	$D_{19}$	$D_{20}$	$D_{21}$	$D_{22}$	$D_{23}$	$D_{24}$	$D_{25}$	$D_{26}$	$D_{27}$	$D_{28}$	$D_{29}$	$D_{30}$	$D_{31}$
3	$D_{24}$	$D_{25}$	$D_{26}$	$D_{27}$	$D_{28}$	$D_{29}$	$D_{30}$	$D_{31}$	$D_{32}$	$D_{33}$	$D_{34}$	$D_{35}$	$D_{36}$	$D_{37}$	$D_{38}$	$D_{39}$
4	$D_{32}$	$D_{33}$	$D_{34}$	$D_{35}$	$D_{36}$	$D_{37}$	$D_{38}$	$D_{39}$	$D_{40}$	$D_{41}$	$D_{42}$	$D_{43}$	$D_{44}$	$D_{45}$	$D_{46}$	$D_{47}$
5	$D_{40}$	$D_{41}$	$D_{42}$	$D_{43}$	$D_{44}$	$D_{45}$	$D_{46}$	$D_{47}$	$D_{48}$	$D_{49}$	$D_{50}$	$D_{51}$	$D_{52}$	$D_{53}$	$D_{54}$	$D_{55}$
6	$D_{48}$	$D_{49}$	$D_{50}$	$D_{51}$	$D_{52}$	$D_{53}$	$D_{54}$	$D_{55}$	$D_{56}$	$D_{57}$	$D_{58}$	$D_{59}$	$D_{60}$	$D_{61}$	$D_{62}$	$D_{63}$
7	$D_{56}$	$D_{57}$	$D_{58}$	$D_{59}$	$D_{60}$	$D_{61}$	$D_{62}$	$D_{63}$	$D_{64}$	$D_{65}$	$D_{66}$	$D_{67}$	$D_{68}$	$D_{69}$	$D_{70}$	$D_{71}$

**FIG. 53**      *Tone Mapping of (4 x 4) Interleaved Matrix Elements*

		Column number			
		0	1	2	3
Row number	0	CLC <sub>i</sub> (0) <sup>a</sup>	CLC <sub>i</sub> (4)	CLC <sub>i</sub> (8)	CLC <sub>i</sub> (12)
	1	CLC <sub>i</sub> (1)	CLC <sub>i</sub> (5)	CLC <sub>i</sub> (9)	CLC <sub>i</sub> (13)
	2	CLC <sub>i</sub> (2)	CLC <sub>i</sub> (6)	CLC <sub>i</sub> (10)	CLC <sub>i</sub> (14)
	3	CLC <sub>i</sub> (3)	CLC <sub>i</sub> (7)	CLC <sub>i</sub> (11)	CLC <sub>i</sub> (15)

a. *i* is the subband pair index (0, 1, 2, or 3).

FIG. 54 Block Diagram representation of BRC Physical layer format.

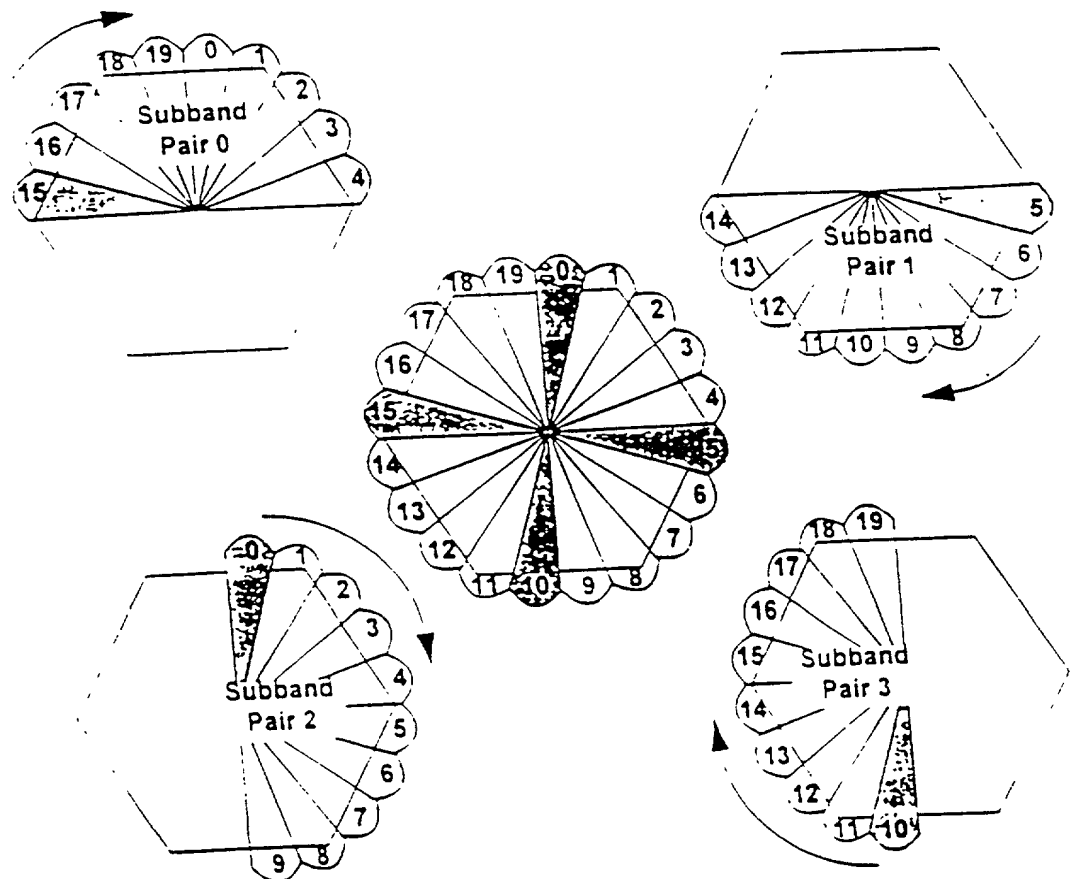


**FIG. 55**      *Tone Mapping the (4x 4) Intereaved Matrix Elements*

		Column number			
		0	1	2	3
Row number	0	$BRC_i(0)^a$	$BRC_i(4)$	$BRC_i(8)$	$BRC_i(12)$
	1	$BRC_i(1)$	$BRC_i(5)$	$BRC_i(9)$	$BRC_i(13)$
	2	$BRC_i(2)$	$BRC_i(6)$	$BRC_i(10)$	$BRC_i(14)$
	3	$BRC_i(3)$	$BRC_i(7)$	$BRC_i(11)$	$BRC_i(15)$

a.  $i$  is the subband pair index (0, 1, 2, or 3). For the broadcast channel all the subband pairs will be active at the same time.

**FIG. 56** Broadcast Channel Beam Sweep



Beam sweeping order										
0	15	16	17	18	19	0	1	2	3	4
1	5	6	7	8	9	10	11	12	13	14
2	0	1	2	3	4	5	6	7	8	9
3	10	11	12	13	14	15	16	17	18	19

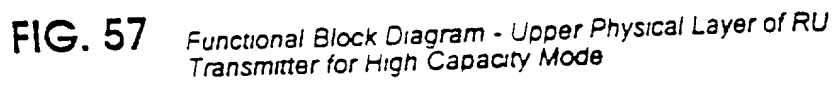


FIG. 58

Data Transformation Diagram - High Capacity Reverse Channel Transmissions

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47

Triple DES encryption

Binary

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47

Data randomization

Binary

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47

Bit to symbol conversion

Binary

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

0-7 Integer Alphabet

LCC symbol added

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

0-7 Integer Alphabet

Trellis encoding

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Pilot symbol insertion

16QAM (16PSK) Complex Alphabet

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

16QAM (16PSK) Complex Alphabet

Smearing

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

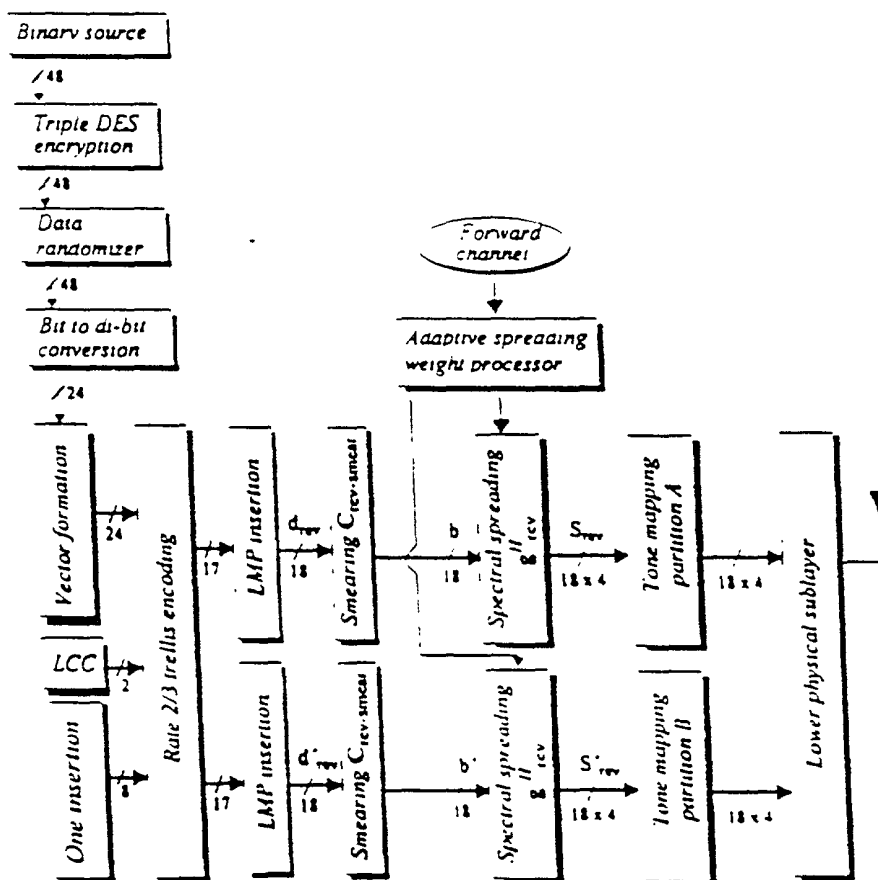
Complex

4 Times spectral spreading

0	1	2	3
4	5	6	7
8	9	10	11
12	13	14	15
16	17	18	19
20	21	22	23
24	25	26	27
28	29	30	31
32	33	34	35
36	37	38	39
40	41	42	43
44	45	46	47
48	49	50	51
52	53	54	55
56	57	58	59
60	61	62	63
64	65	66	67
68	69	70	71

Complex

**FIG. 59** Functional Block Diagram - Upper Physical Layer of RU Transmitter for Medium Capacity Mode



**FIG. 60**

*Data Transformation Diagram - Medium Capacity Reverse Channel Transmissions*

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47

*Triple DES encryption*

*Binary*

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47

*Randomization*

*Binary*

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47

*Bit to symbol conversion*

*Binary*

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

*0-3 Integer Alphabet*

*LCC symbol insertion-one padding*

*LCC ones*

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

*0-3 Integer Alphabet*

*Trellis encoding*

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33

*Pilot symbol insertion*

*0-3 Integer Alphabet*

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33

*0-3 Integer Alphabet*

*Smearing*

*Smearing*

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17

*Complex*

*4 Times spreading*

*Time spreading*

0	1	2	3
4	5	6	7
8	9	10	11
12	13	14	15
16	17	18	19
20	21	22	23
24	25	26	27
28	29	30	31
32	33	34	35
36	37	38	39
40	41	42	43
44	45	46	47

Partition A

0	1	2	3
4	5	6	7
8	9	10	11
12	13	14	15
16	17	18	19
20	21	22	23
24	25	26	27
28	29	30	31
32	33	34	35
36	37	38	39
40	41	42	43
44	45	46	47

Partition B

*Complex*

FIG. 61

**Functional Block Diagram - Upper Physical Layer of RU Transmitter for Low Capacity Mode**

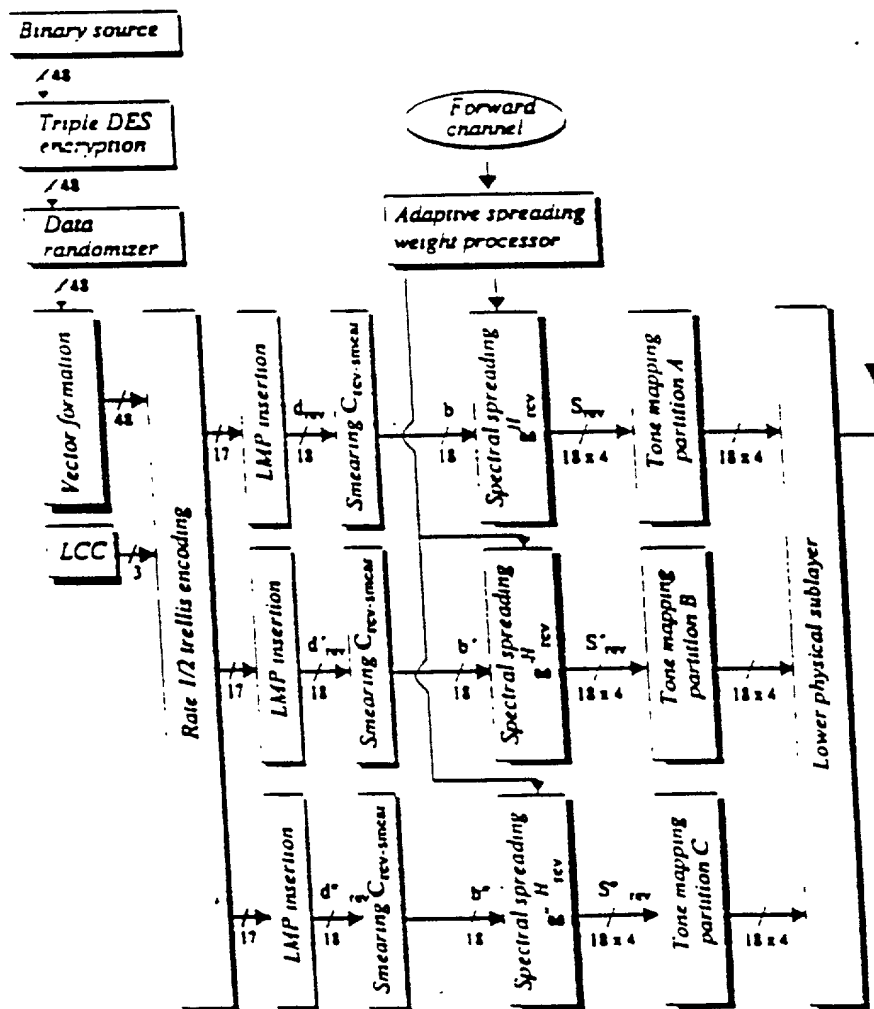


FIG. 62

Data Transformation Diagram - Low Capacity Reverse Channel Transmissions

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 Binary

Triple DES encryption

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 Binary

LCC symbol insertion-one padding

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 Binary

Trellis encoding

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 QPSK Complex Alphabet

Pilot symbol insertion

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 QPSK Complex Alphabet

Smearing

Smearing

Smearing

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 Complex

4 Times spreading

4 Times spreading

4 Times spreading

0 1 2 3  
4 5 6 7  
8 9 10 11  
12 13 14 15  
16 17 18 19  
20 21 22 23  
24 25 26 27  
28 29 30 31  
32 33 34 35  
36 37 38 39  
40 41 42 43  
44 45 46 47  
48 49 50 51  
52 53 54 55  
56 57 58 59  
60 61 62 63  
64 65 66 67  
68 69 70 71  
72 73 74 75  
76 77 78 79  
80 81 82 83  
84 85 86 87  
88 89 90 91  
92 93 94 95  
96 97 98 99  
100 101 102 103  
104 105 106 107  
108 109 110 111  
112 113 114 115  
116 117 118 119  
120 121 122 123  
124 125 126 127  
128 129 130 131  
132 133 134 135  
136 137 138 139  
140 141 142 143  
144 145 146 147  
148 149 150 151  
152 153 154 155  
156 157 158 159  
160 161 162 163  
164 165 166 167  
168 169 170 171  
172 173 174 175  
176 177 178 179  
180 181 182 183  
184 185 186 187  
188 189 190 191  
192 193 194 195  
196 197 198 199  
200 201 202 203  
204 205 206 207  
208 209 210 211  
212 213 214 215  
216 217 218 219  
220 221 222 223  
224 225 226 227  
228 229 230 231  
232 233 234 235  
236 237 238 239  
240 241 242 243  
244 245 246 247  
248 249 250 251  
252 253 254 255  
256 257 258 259  
260 261 262 263  
264 265 266 267  
268 269 270 271  
272 273 274 275  
276 277 278 279  
280 281 282 283  
284 285 286 287  
288 289 290 291  
292 293 294 295  
296 297 298 299  
300 301 302 303  
304 305 306 307  
308 309 310 311  
312 313 314 315  
316 317 318 319  
320 321 322 323  
324 325 326 327  
328 329 330 331  
332 333 334 335  
336 337 338 339  
340 341 342 343  
344 345 346 347  
348 349 350 351  
352 353 354 355  
356 357 358 359  
360 361 362 363  
364 365 366 367  
368 369 370 371  
372 373 374 375  
376 377 378 379  
380 381 382 383  
384 385 386 387  
388 389 390 391  
392 393 394 395  
396 397 398 399  
400 401 402 403  
404 405 406 407  
408 409 410 411  
412 413 414 415  
416 417 418 419  
420 421 422 423  
424 425 426 427  
428 429 430 431  
432 433 434 435  
436 437 438 439  
440 441 442 443  
444 445 446 447  
448 449 450 451  
452 453 454 455  
456 457 458 459  
460 461 462 463  
464 465 466 467  
468 469 470 471  
472 473 474 475  
476 477 478 479  
480 481 482 483  
484 485 486 487  
488 489 490 491  
492 493 494 495  
496 497 498 499  
500 501 502 503  
504 505 506 507  
508 509 510 511  
512 513 514 515  
516 517 518 519  
520 521 522 523  
524 525 526 527  
528 529 530 531  
532 533 534 535  
536 537 538 539  
540 541 542 543  
544 545 546 547  
548 549 550 551  
552 553 554 555  
556 557 558 559  
560 561 562 563  
564 565 566 567  
568 569 570 571  
572 573 574 575  
576 577 578 579  
580 581 582 583  
584 585 586 587  
588 589 590 591  
592 593 594 595  
596 597 598 599  
600 601 602 603  
604 605 606 607  
608 609 610 611  
612 613 614 615  
616 617 618 619  
620 621 622 623  
624 625 626 627  
628 629 630 631  
632 633 634 635  
636 637 638 639  
640 641 642 643  
644 645 646 647  
648 649 650 651  
652 653 654 655  
656 657 658 659  
660 661 662 663  
664 665 666 667  
668 669 670 671  
672 673 674 675  
676 677 678 679  
680 681 682 683  
684 685 686 687  
688 689 690 691  
692 693 694 695  
696 697 698 699  
700 701 702 703  
704 705 706 707  
708 709 710 711  
712 713 714 715  
716 717 718 719  
720 721 722 723  
724 725 726 727  
728 729 730 731  
732 733 734 735  
736 737 738 739  
740 741 742 743  
744 745 746 747  
748 749 750 751  
752 753 754 755  
756 757 758 759  
760 761 762 763  
764 765 766 767  
768 769 770 771  
772 773 774 775  
776 777 778 779  
780 781 782 783  
784 785 786 787  
788 789 790 791  
792 793 794 795  
796 797 798 799  
800 801 802 803  
804 805 806 807  
808 809 810 811  
812 813 814 815  
816 817 818 819  
820 821 822 823  
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828 829 830 831  
832 833 834 835  
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840 841 842 843  
844 845 846 847  
848 849 850 851  
852 853 854 855  
856 857 858 859  
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864 865 866 867  
868 869 870 871  
872 873 874 875  
876 877 878 879  
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892 893 894 895  
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900 901 902 903  
904 905 906 907  
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956 957 958 959  
960 961 962 963  
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976 977 978 979  
980 981 982 983  
984 985 986 987  
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992 993 994 995  
996 997 998 999  
1000 1001 1002 1003  
1004 1005 1006 1007  
1008 1009 1010 1011  
1012 1013 1014 1015  
1016 1017 1018 1019  
1020 1021 1022 1023  
1024 1025 1026 1027  
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1060 1061 1062 1063  
1064 1065 1066 1067  
1068 1069 1070 1071  
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1076 1077 1078 1079  
1080 1081 1082 1083  
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1092 1093 1094 1095  
1096 1097 1098 1099  
1100 1101 1102 1103  
1104 1105 1106 1107  
1108 1109 1110 1111  
1112 1113 1114 1115  
1116 1117 1118 1119  
1120 1121 1122 1123  
1124 1125 1126 1127  
1128 1129 1130 1131  
1132 1133 1134 1135  
1136 1137 1138 1139  
1140 1141 1142 1143  
1144 1145 1146 1147  
1148 1149 1150 1151  
1152 1153 1154 1155  
1156 1157 1158 1159  
1160 1161 1162 1163  
1164 1165 1166 1167  
1168 1169 1170 1171  
1172 1173 1174 1175  
1176 1177 1178 1179  
1180 1181 1182 1183  
1184 1185 1186 1187  
1188 1189 1190 1191  
1192 1193 1194 1195  
1196 1197 1198 1199  
1200 1201 1202 1203  
1204 1205 1206 1207  
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1244 1245 1246 1247  
1248 1249 1250 1251  
1252 1253 1254 1255  
1256 1257 1258 1259  
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1264 1265 1266 1267  
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1276 1277 1278 1279  
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1304 1305 1306 1307  
1308 1309 1310 1311  
1312 1313 1314 1315  
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1320 1321 1322 1323  
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1328 1329 1330 1331  
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1368 1369 1370 1371  
1372 1373 1374 1375  
1376 1377 1378 1379  
1380 1381 1382 1383  
1384 1385 1386 1387  
1388 1389 1390 1391  
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1396 1397 1398 1399  
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1596 1597 1598 1599  
1600 1601 1602 1603  
1604 1605 1606 1607  
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1644 1645 1646 1647  
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1656 1657 1658 1659  
1660 1661 1662 1663  
1664 1665 1666 1667  
1668 1669 1670 1671  
1672 1673 1674 1675  
1676 1677 1678 1679  
1680 1681 1682 1683  
1684 1685 1686 1687  
1688 1689 1690 1691  
1692 1693 1694 1695  
1696 1697 1698 1699  
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1704 1705 1706 1707  
1708 1709 1710 1711  
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1844 1845 1846 1847  
1848 1849 1850 1851  
1852 1853 1854 1855  
1856 1857 1858 1859  
1860 1861 1862 1863  
1864 1865 1866 1867  
1868 1869 1870 1871  
1872 1873 1874 1875  
1876 1877 1878 1879  
1880 1881 1882 1883  
1884 1885 1886 1887  
1888 1889 1890 1891  
1892 1893 1894 1895  
1896 1897 1898 1899  
1900 1901 1902 1903  
1904 1905 1906 1907  
1908 1909 1910 1911  
1912 1913 1914 1915  
1916 1917 1918 1919  
1920 1921 1922 1923  
1924 1925 1926 1927  
1928 1929 1930 1931  
1932 1933 1934 1935  
1936 1937 1938 1939  
1940 1941 1942 1943  
1944 1945 1946 1947  
1948 1949 1950 1951  
1952 1953 1954 1955  
1956 1957 1958 1959  
1960 1961 1962 1963  
1964 1965 1966 1967  
1968 1969 1970 1971  
1972 1973 1974 1975  
1976 1977 1978 1979  
1980 1981 1982 1983  
1984 1985 1986 1987  
1988 1989 1990 1991  
1992 1993 1994 1995  
1996 1997 1998 1999  
2000 2001 2002 2003  
2004 2005 2006 2007  
2008 2009 2010 2011  
2012 2013 2014 2015  
2016 2017 2018 2019  
2020 2021 2022 2023  
2024 2025 2026 2027  
2028 2029 2030 2031  
2032 2033 2034 2035  
2036 2037 2038 2039  
2040 2041 2042 2043  
2044 2045 2046 2047  
2048 2049 2050 2051  
2052 2053 2054 2055  
2056 2057 2058 2059  
2060 2061 2062 2063  
2064 2065 2066 2067  
2068 2069 2070 2071  
2072 2073 2074 2075  
2076 2077 2078 2079  
2080 2081 2082 2083  
2084 2085 2086 2087  
2088 2089 2090 2091  
2092 2093 2094 2095  
2096 2097 2098 2099  
2100 2101 2102 2103  
2104 2105 2106 2107  
2108 2109 2110 2111  
2112 2113 2114 2115  
2116 2117 2118 2119  
2120 2121 2122 2123  
2124 2125 2126 2127  
2128 2129 2130 2131  
2132 2133 2134 2135  
2136 2137 2138 2139  
2140 2141 2142 2143  
2144 2145 2146 2147  
2148 2149 2150 2151  
2152 2153 2154 2155  
2156 2157 2158 2159  
2160 2161 2162 2163  
2164 2165 2166 2167  
2168 2169 2170 2171  
2172 2173 2174 2175  
2176 2177 2178 2179  
2180 2181 2182 2183  
2184 2185 2186 2187  
2188 2189 2190 2191  
2192 2193 2194 2195  
2196 2197 2198 2199  
2200 2201 2202 2203  
2204 2205 2206 2207  
2208 2209 2210 2211  
2212 2213 2214 2215  
2216 2217 2218 2219  
2220 2221 2222 2223  
2224 2225 2226 2227  
2228 2229 2230 2231  
2232 2233 2234 2235  
2236 2237 2238 2239  
2240 2241 2242 2243  
2244 2245 2246 2247  
2248 2249 2250 2251  
2252 2253 2254 2255  
2256 2257 2258 2259  
2260 2261 226

**FIG. 63** *RU Tone Mapping of Received Weight Vector Elements*

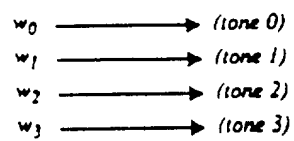
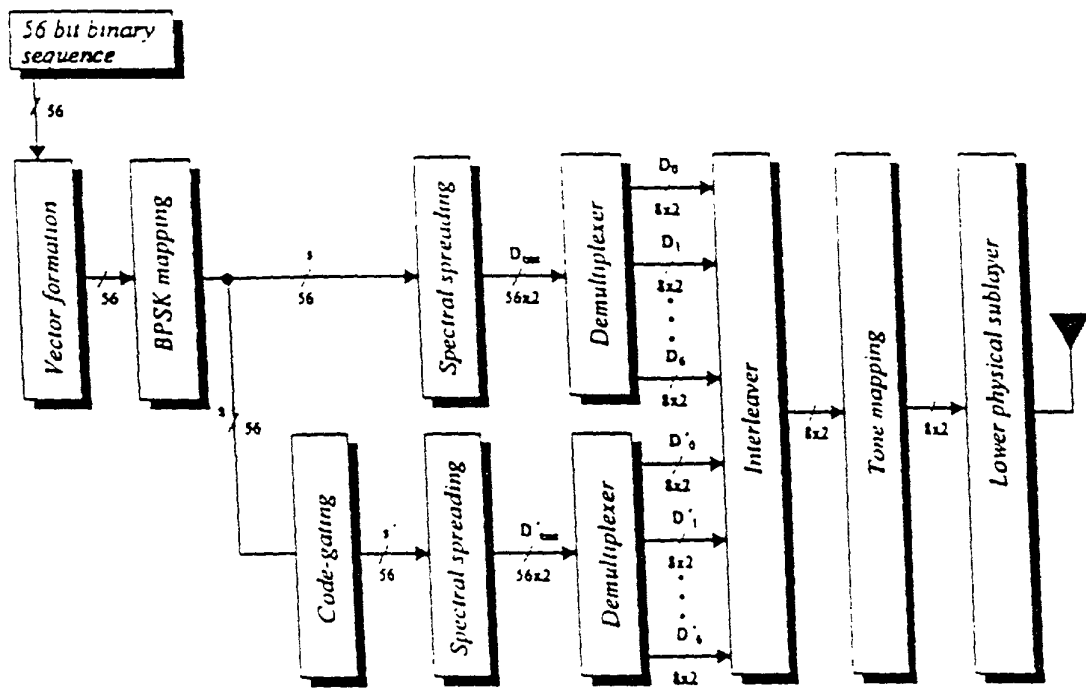


FIG. 64 Block Diagram Representation of CAC Physical Layer Format



**FIG. 65** BPSK Signal Mapping for the CAC Channel

▲ Imaginary (quadrature)



**FIG. 65'** *BPSK Signal Mapping for the CAC Channel*

Bit	Signal mapping	
	In Phase	Quadrature
0	1	0
1	-1	0

FIG. 66 *The CAC Interleaving Rule*

		Burst number													
		0	1	2	3	4	5	6	7	8	9	10	11	12	13
Matrix		$D_0$	$D_1$	$D_2$	$D_3$	$D_4$	$D_5$	$D_6$	$D_7$	$D_8$	$D_9$	$D_{10}$	$D_{11}$	$D_{12}$	$D_{13}$

FIG. 67

**FIG. 67** Tone Mapping the (8 x 2) Interleaved Matrix Elements

		Column Number	
		0	1
Row Number	0	$CAC_{i,j}(0)^a$	$CAC_{i,j}(8)$
	1	$CAC_{i,j}(1)$	$CAC_{i,j}(9)$
	2	$CAC_{i,j}(2)$	$CAC_{i,j}(10)$
	3	$CAC_{i,j}(3)$	$CAC_{i,j}(11)$
	4	$CAC_{i,j}(4)$	$CAC_{i,j}(12)$
	5	$CAC_{i,j}(5)$	$CAC_{i,j}(13)$
	6	$CAC_{i,j}(6)$	$CAC_{i,j}(14)$
	7	$CAC_{i,j}(7)$	$CAC_{i,j}(15)$

a. i is the subband pair index (0, 1, 2, or 3) and j is the CAC ID (0 or 1)

FIG. 68

FIG. 68

Functional Block Diagram - Lower Physical Layer of Base Transmitter

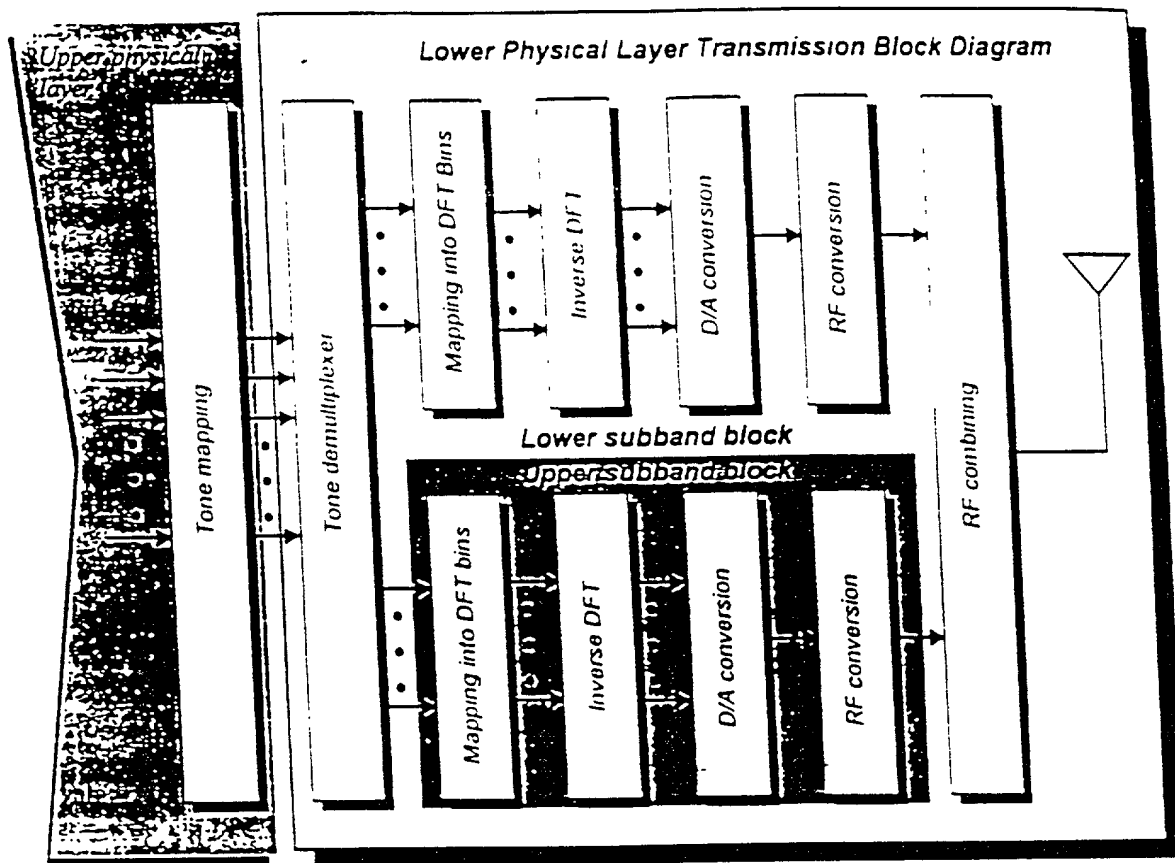
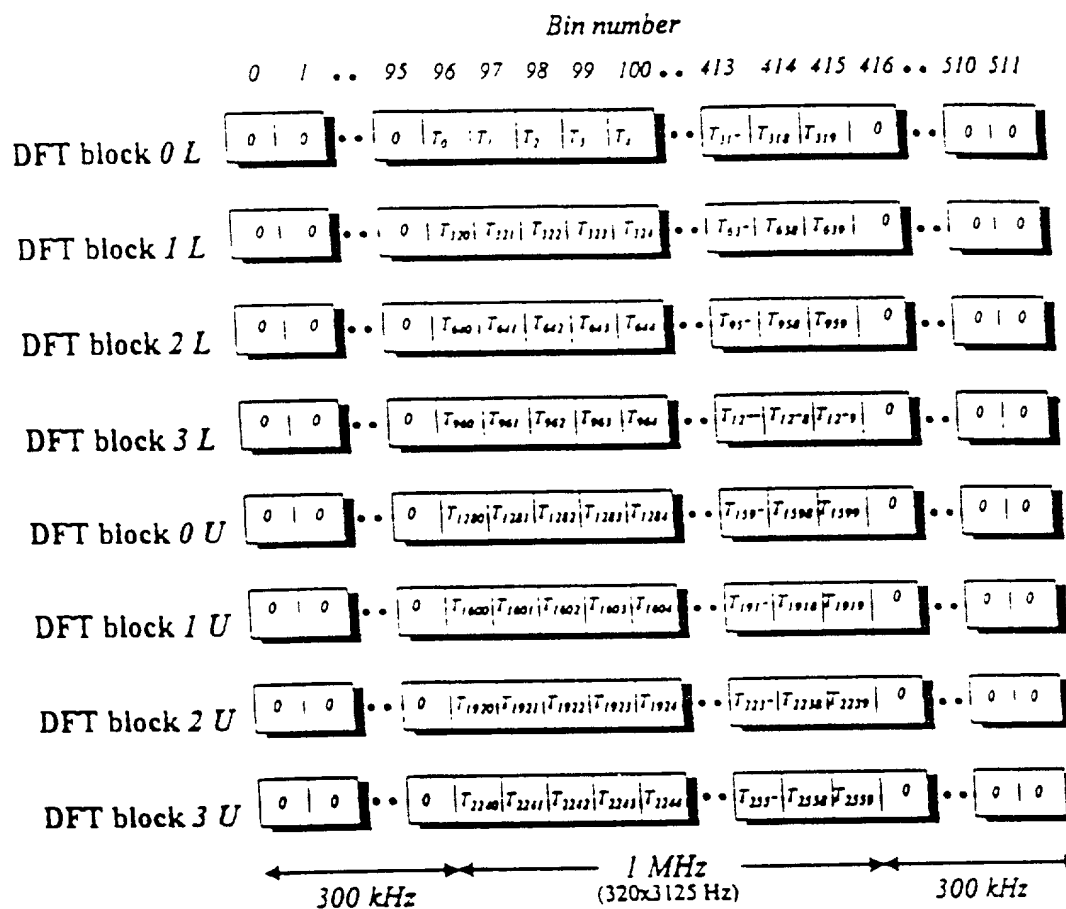


FIG. 69

**FIG. 69** Tone Mapping into DFT Bins

			Bin number		
			Bin 0 to Bin 95	Bin 96 to Bin 415	Bin 416 to Bin 511
DFT pair	0	lower	Unused	T <sub>0</sub> to T <sub>319</sub>	Unused
		upper		T <sub>1280</sub> to T <sub>1599</sub>	
	1	lower		T <sub>320</sub> to T <sub>639</sub>	
		upper		T <sub>1600</sub> to T <sub>1919</sub>	
	2	lower		T <sub>640</sub> to T <sub>959</sub>	
		upper		T <sub>1920</sub> to T <sub>2239</sub>	
	3	lower		T <sub>960</sub> to T <sub>1279</sub>	
		upper		T <sub>2240</sub> to T <sub>2559</sub>	

**FIG. 70** *Tone Mapping into DFT Bins*



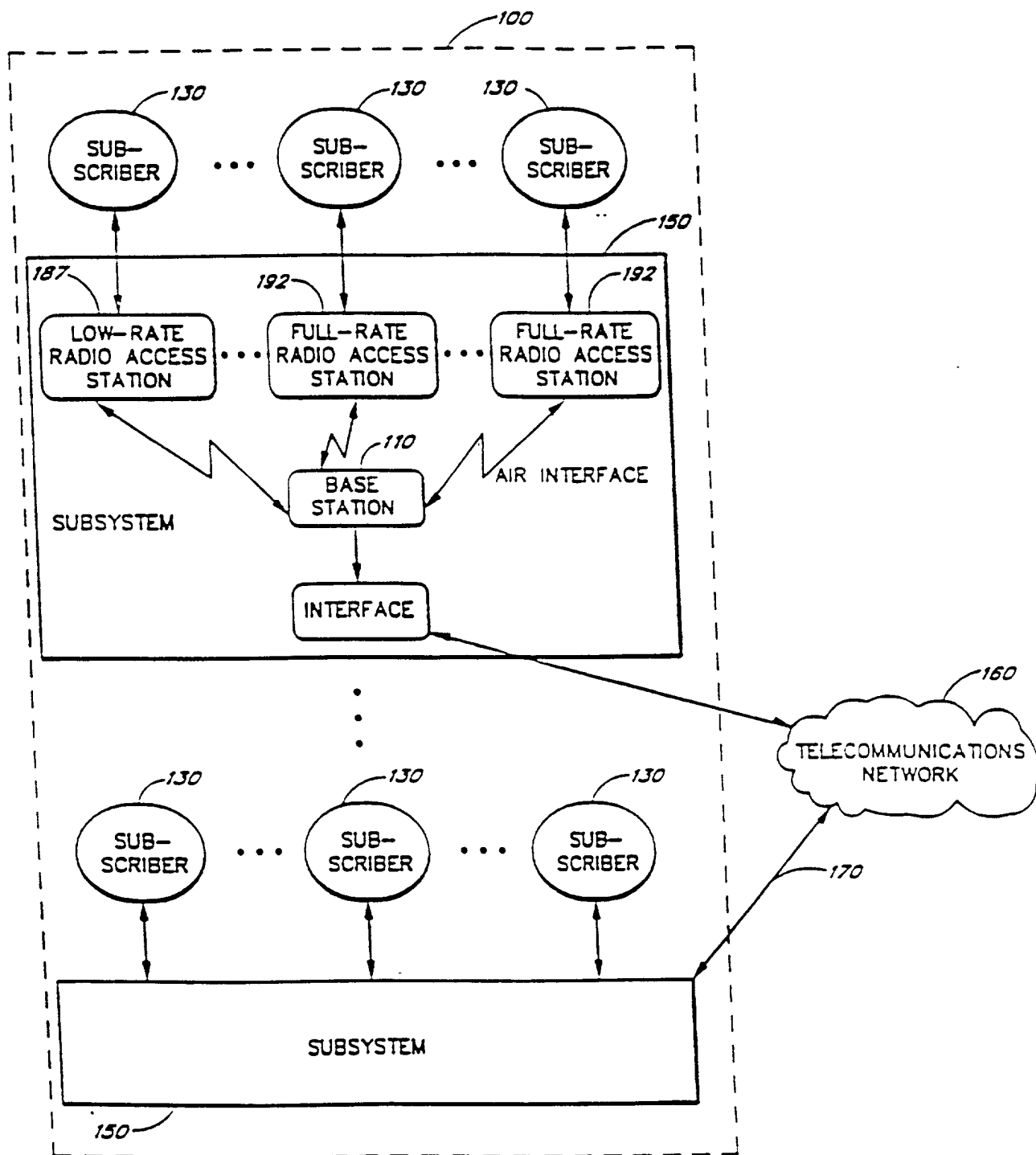


FIG. 71

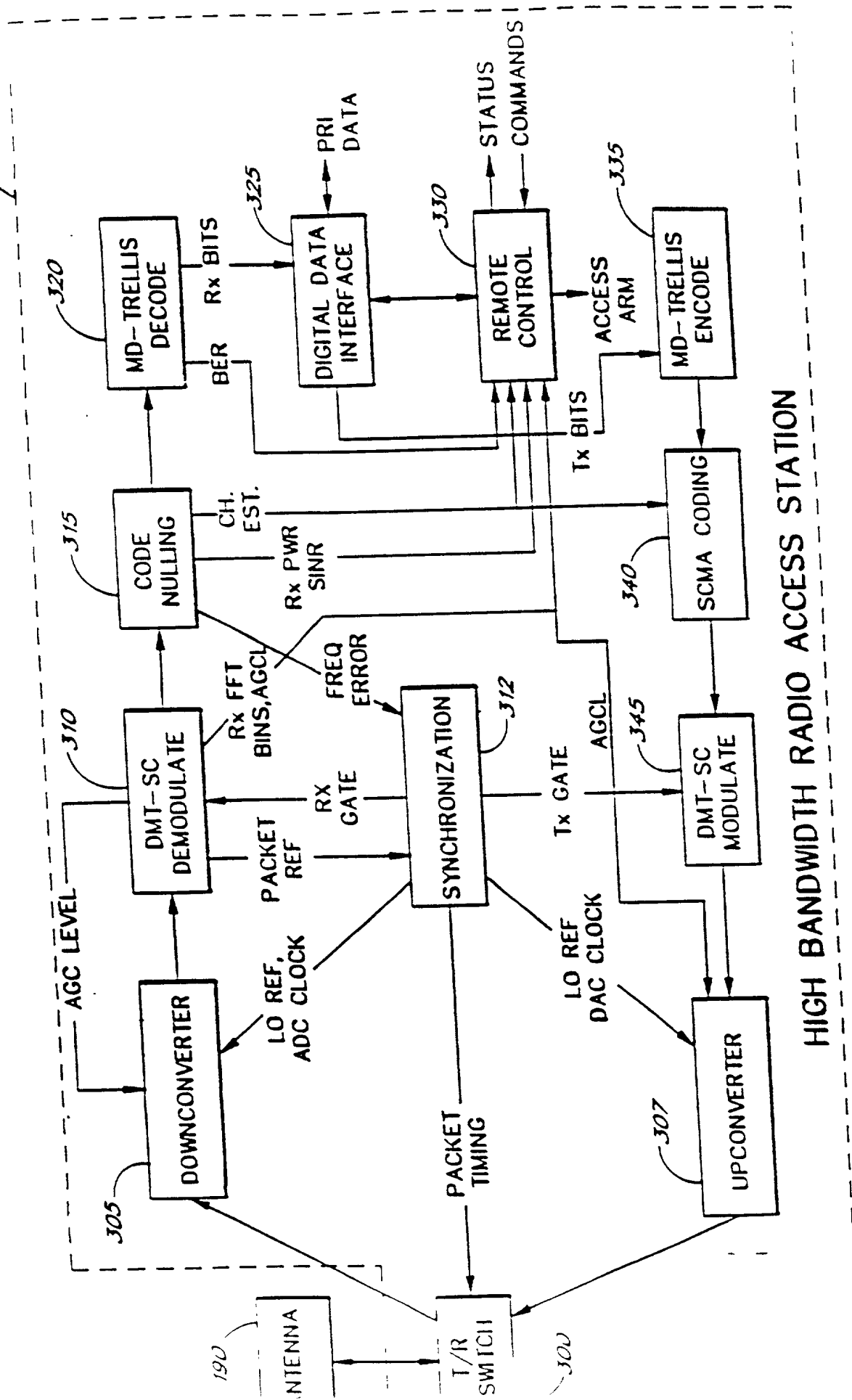


FIG. 72

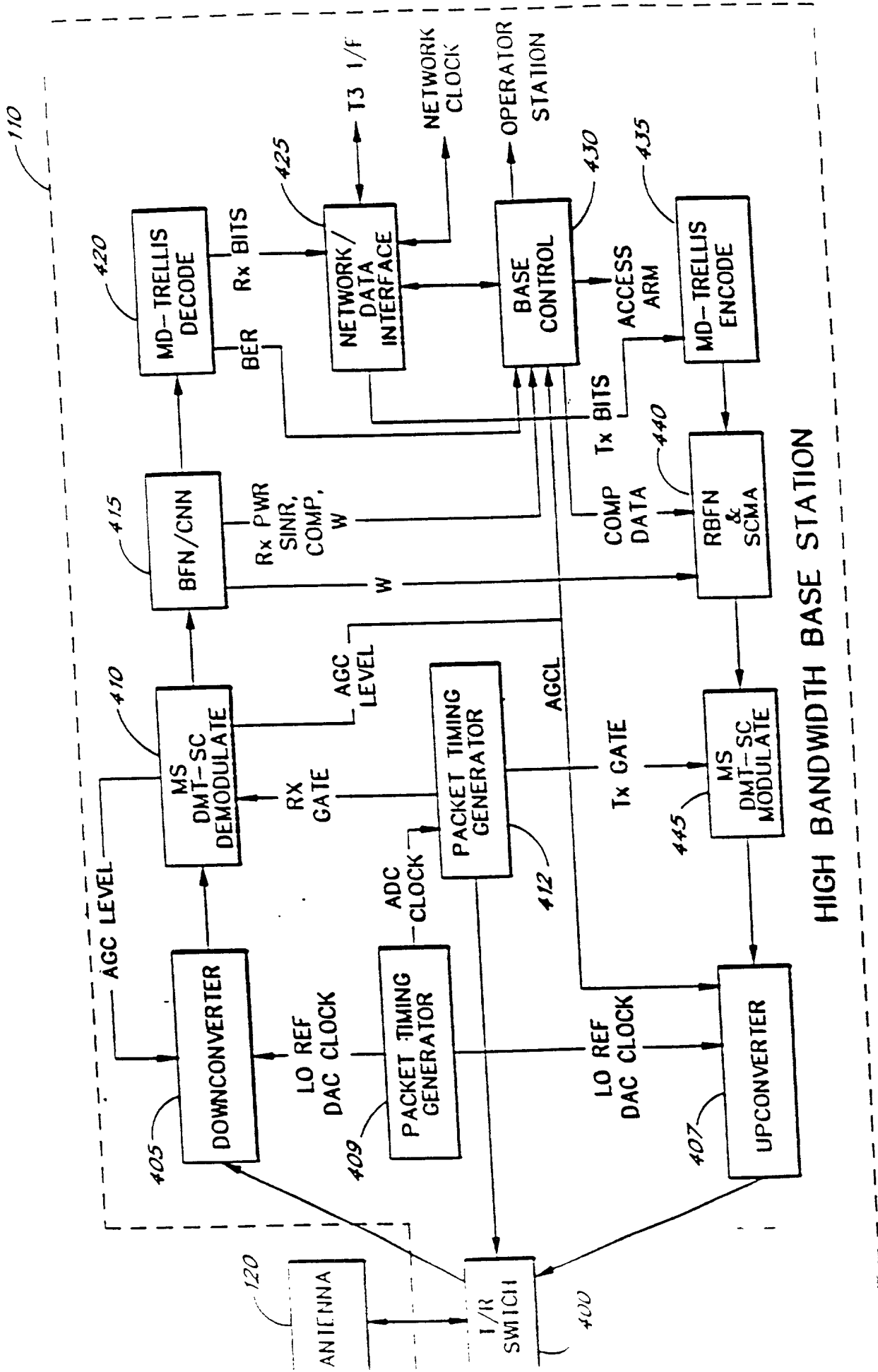


FIG. 73

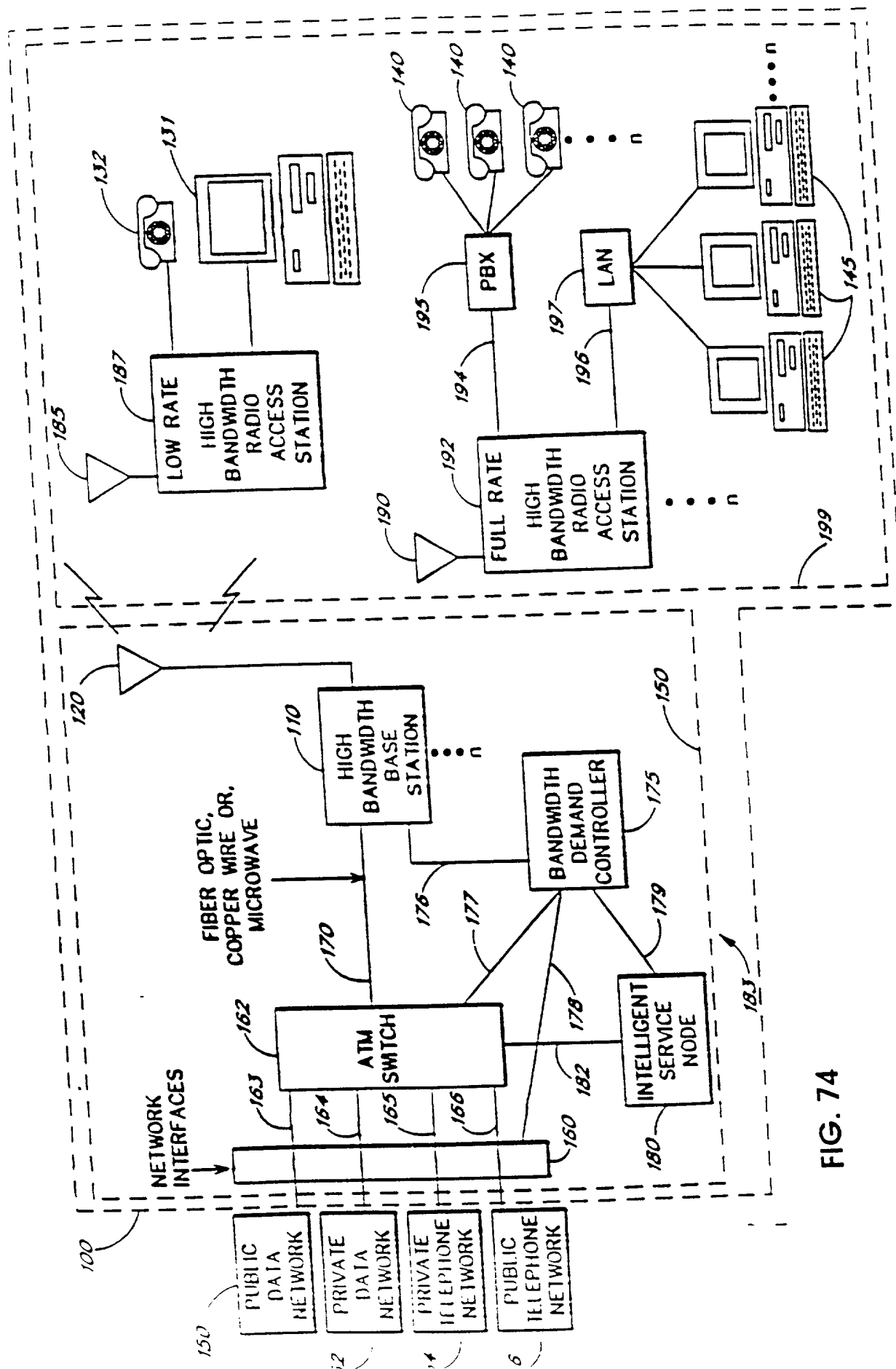


FIG. 74

SAMPLED RECEIVE DATA  
(FROM RECEIVER D/A)

ETHERNET (FROM MAC)

GPS TIME DATA

TUNER CONTROL BITS

FIG. 75

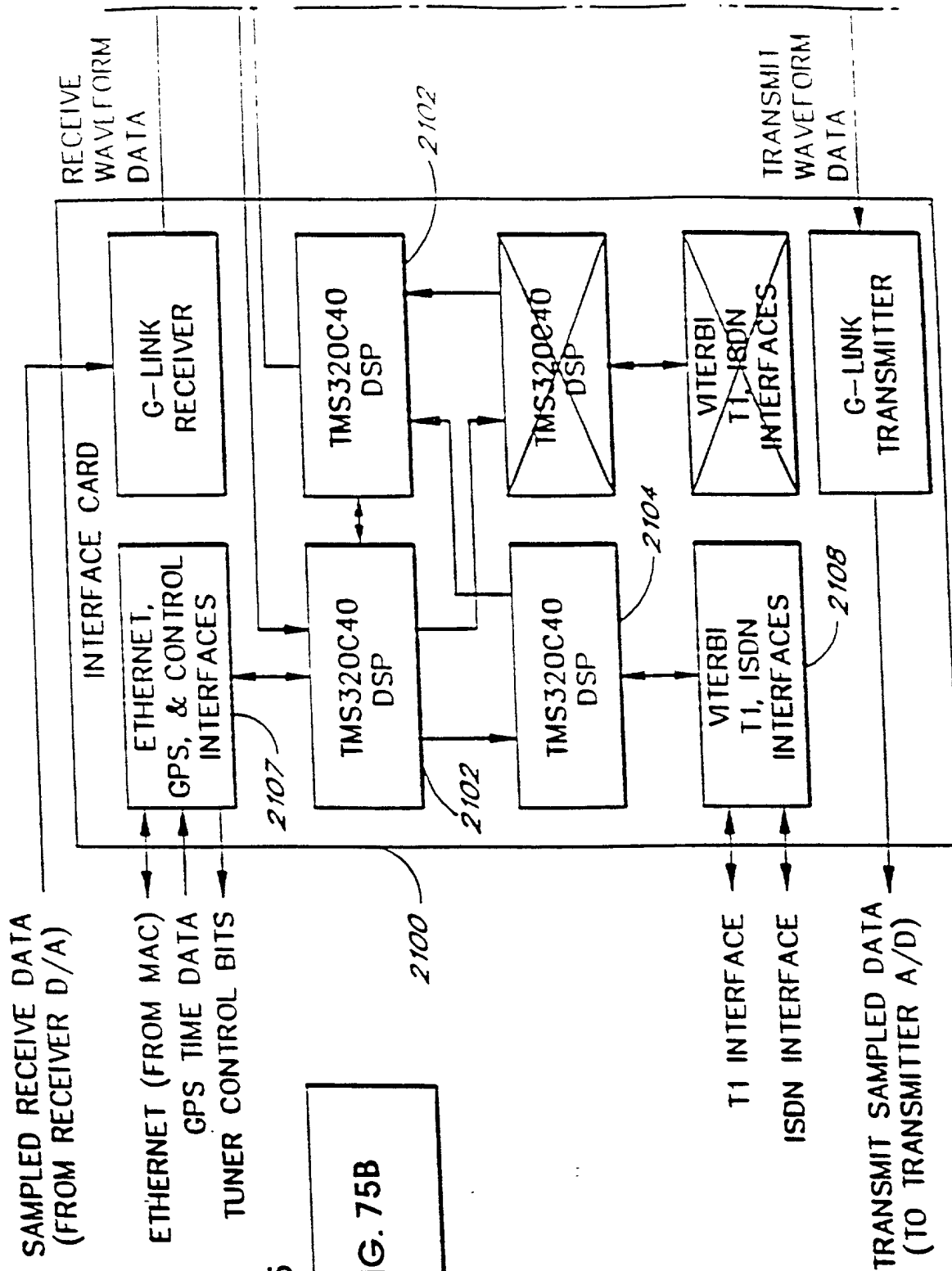
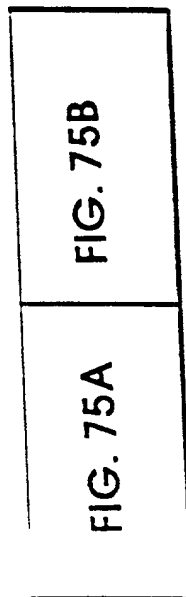


FIG. 75A

INDICATES UNUSED HARDWARE IN REMOTE



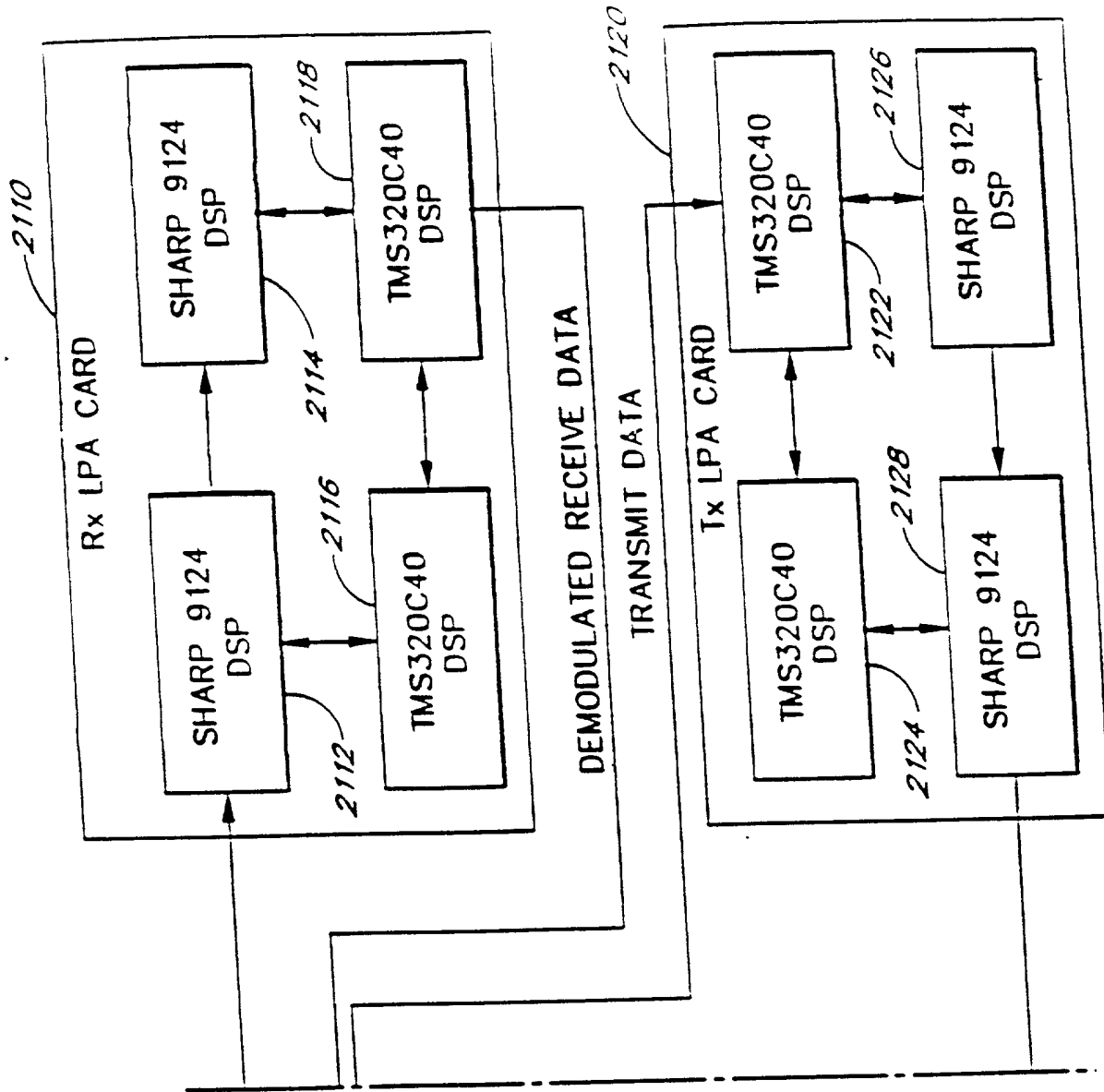


FIG. 75B

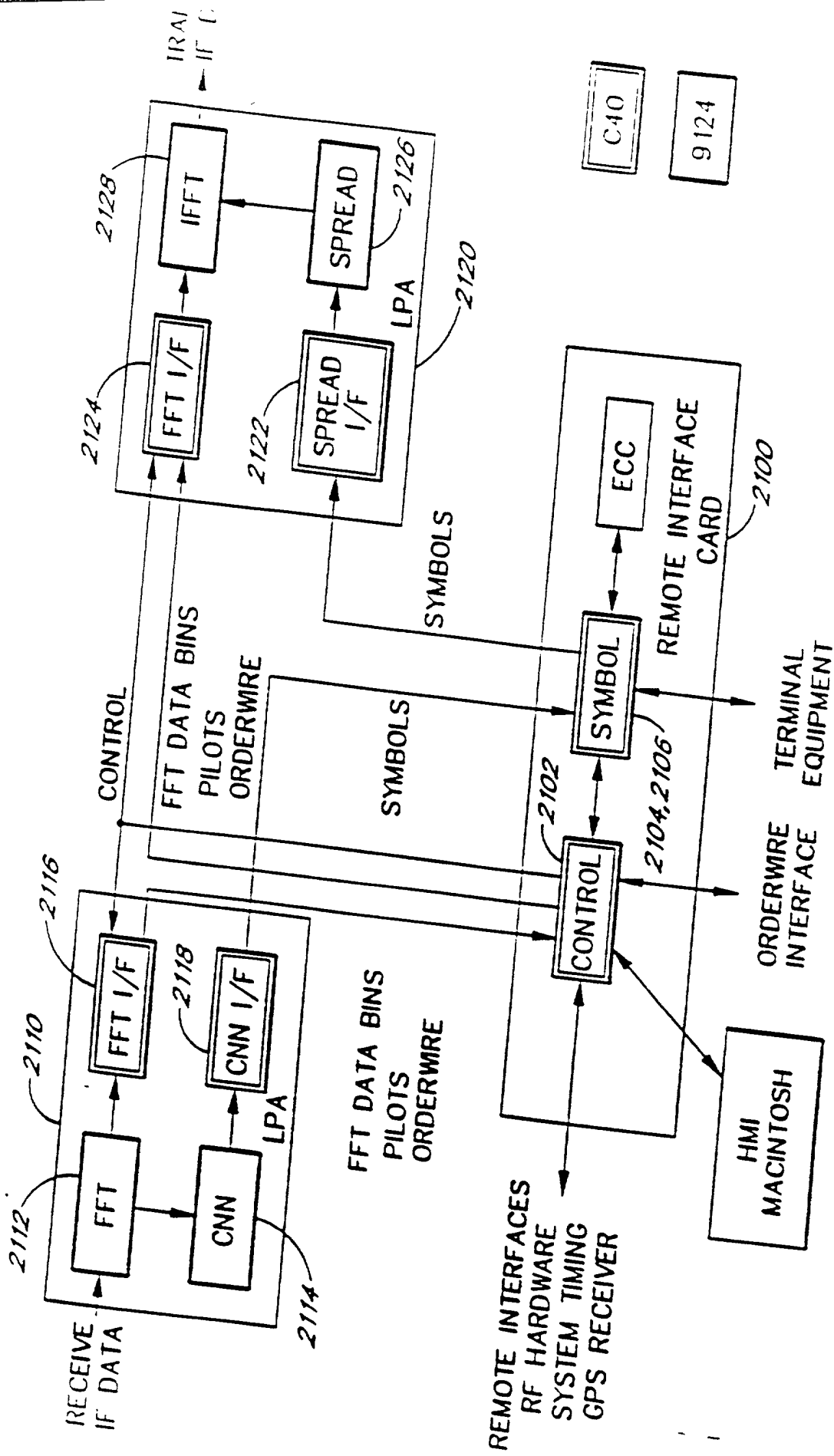


FIG. 76

FIG. 77A

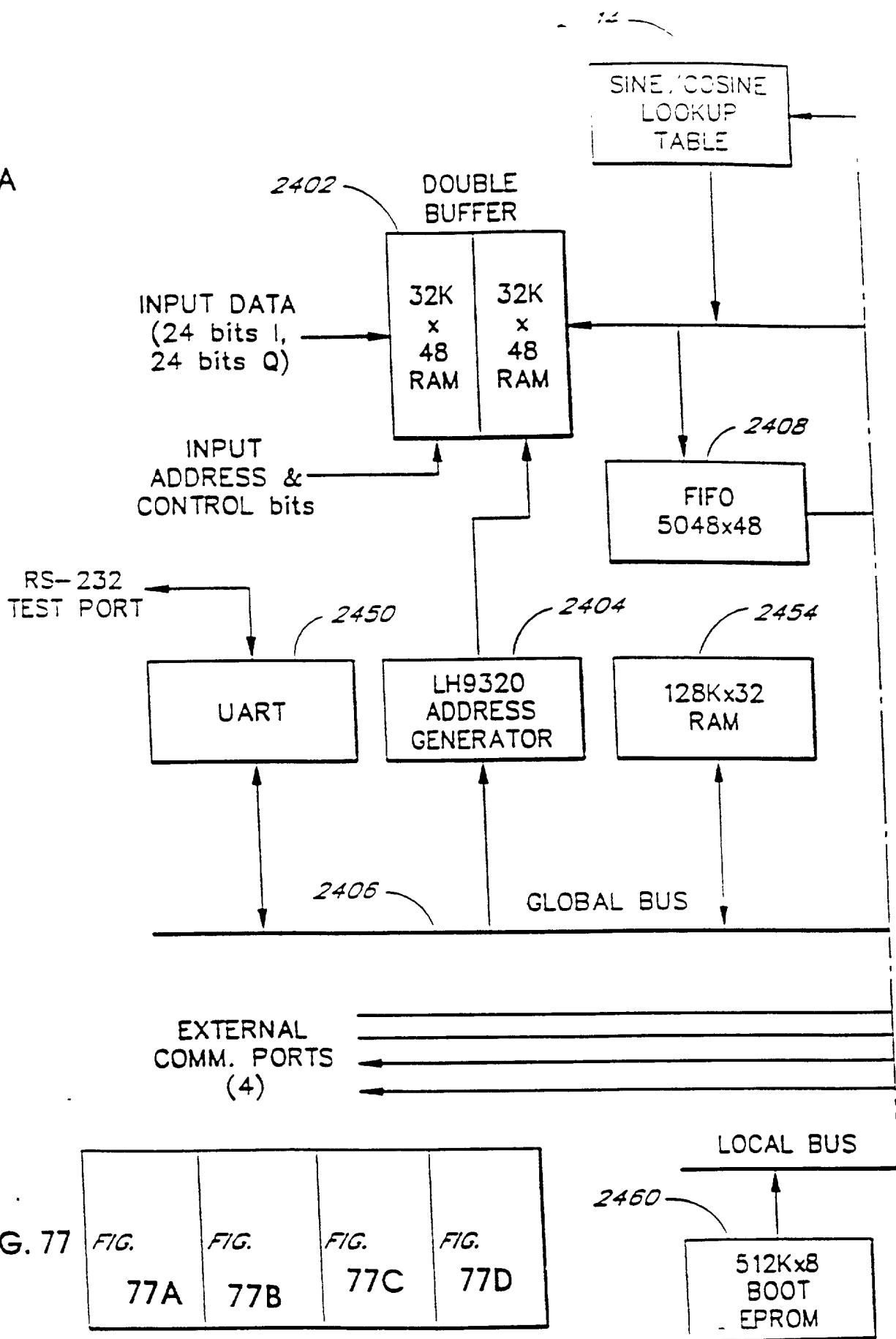


FIG. 77

FIG.	FIG.	FIG.	FIG.
77A	77B	77C	77D

TOP SECRET E0602660

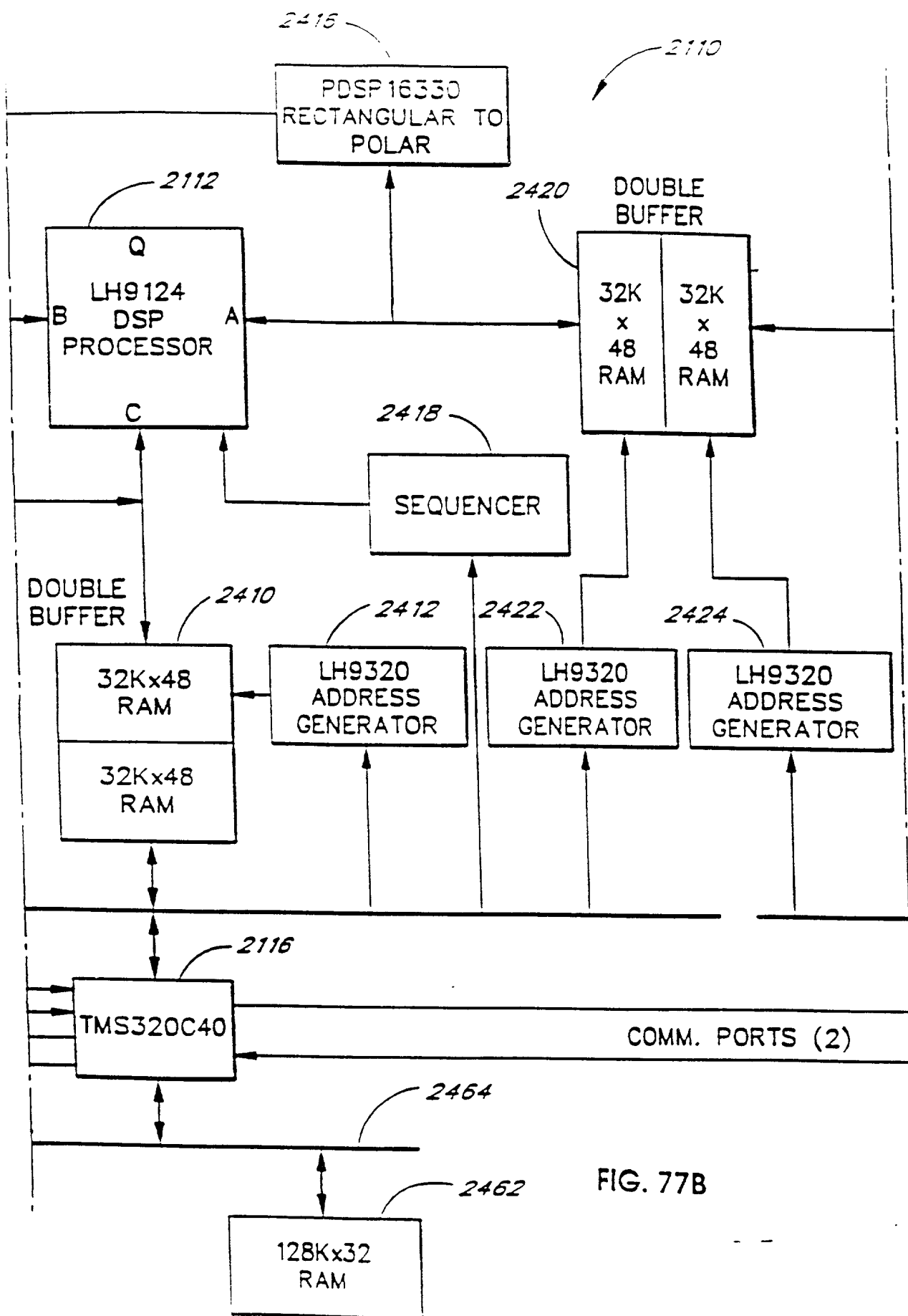


FIG. 77B

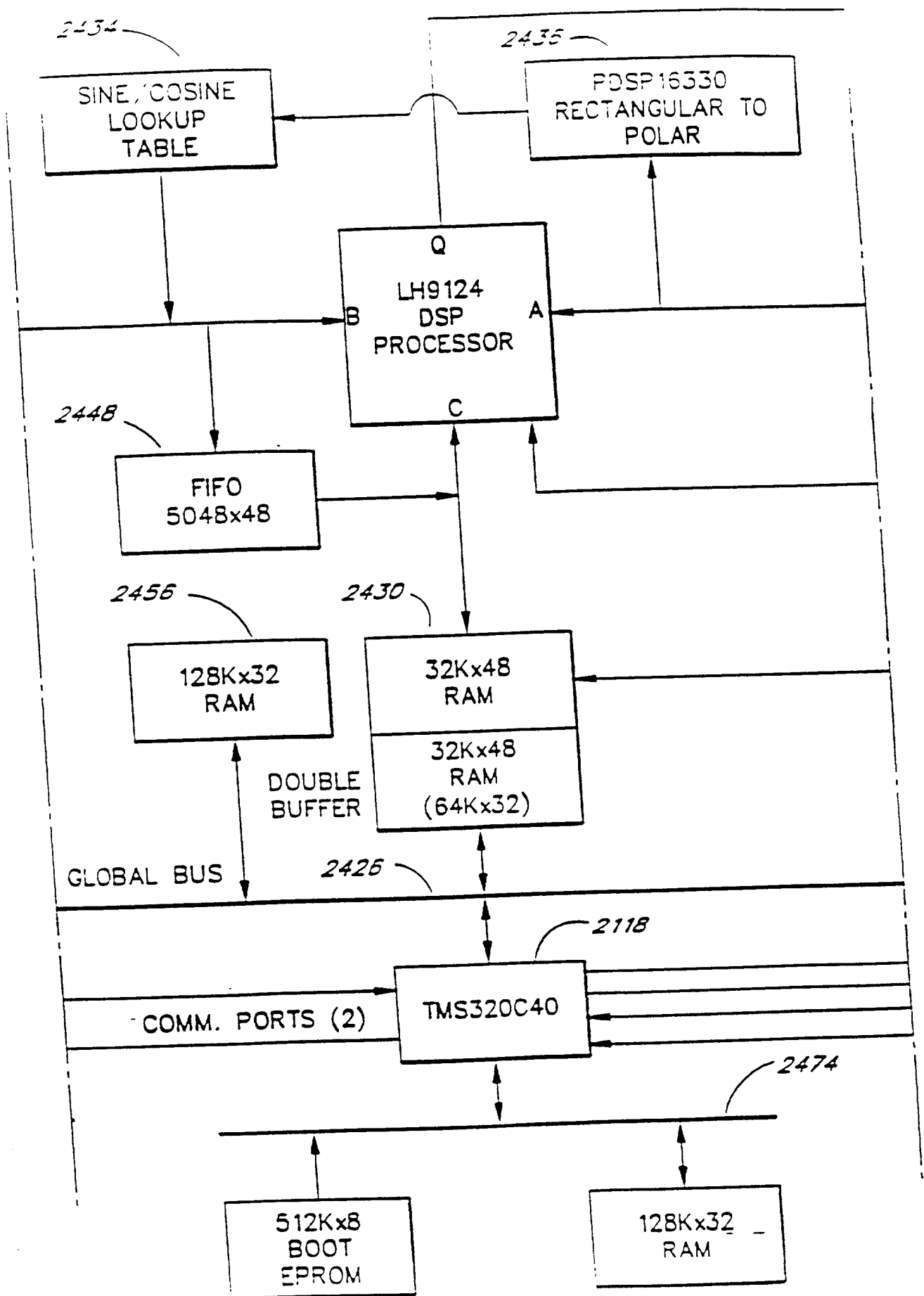


FIG. 77C

TOP SECRET

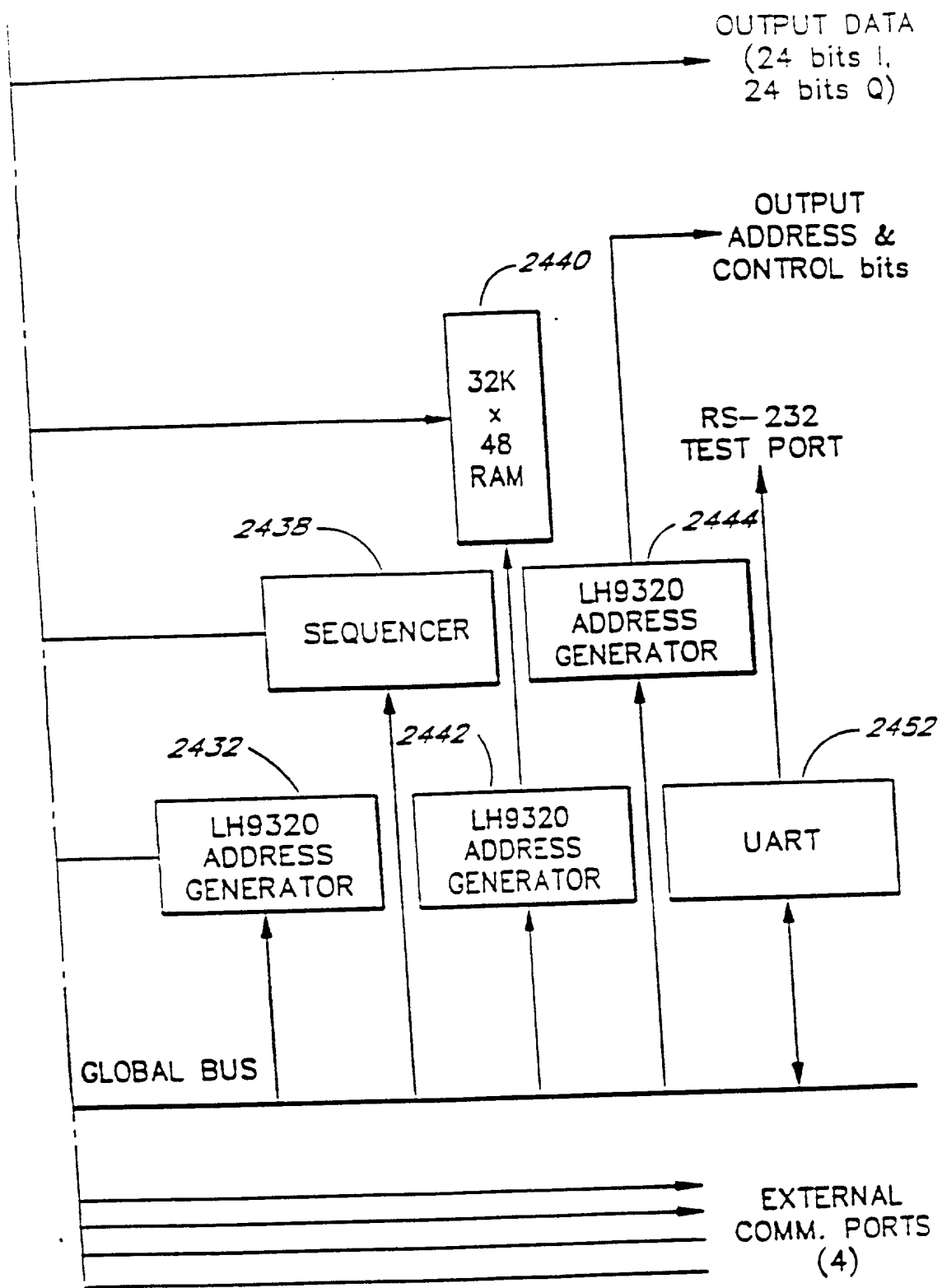


FIG. 77D

FIG. 78

FIG.

78A

FIG.

78B

FIG.

78C

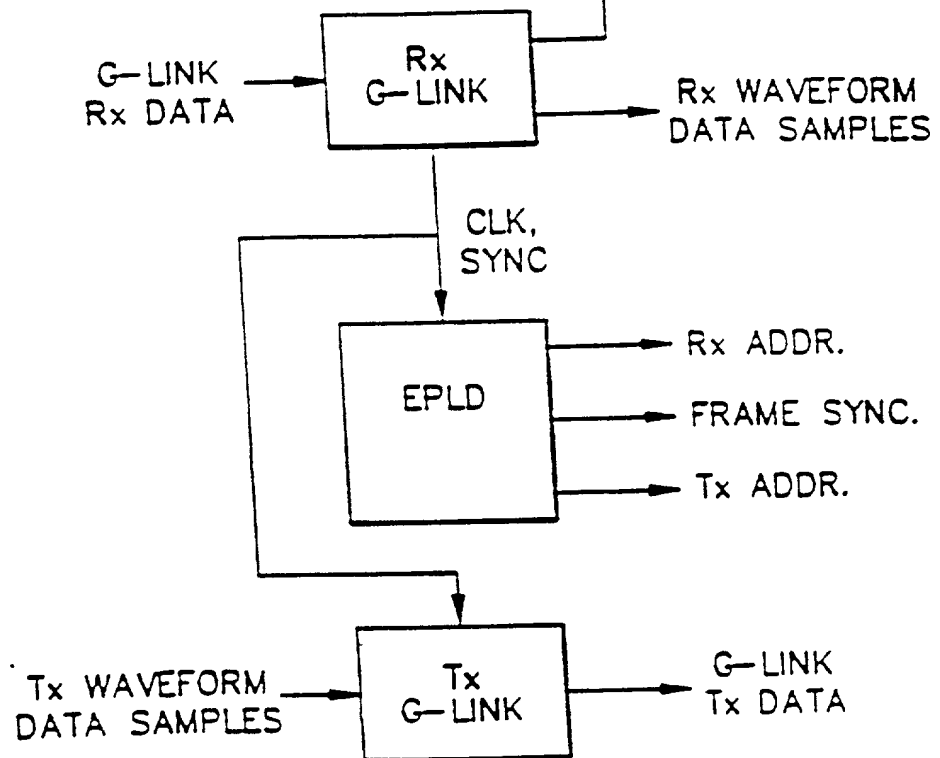


FIG. 78A

FIG. 78B

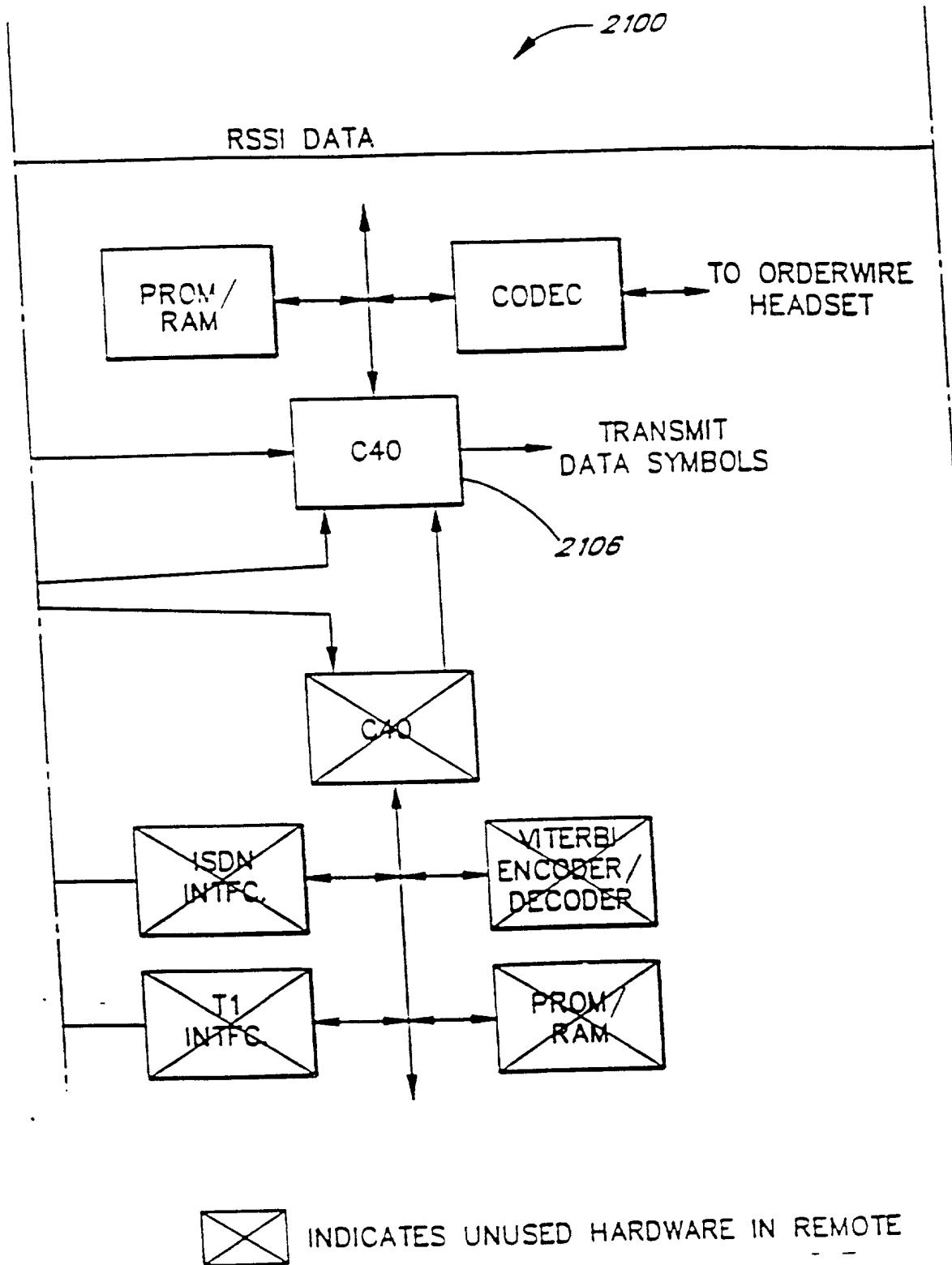


FIG. 78C

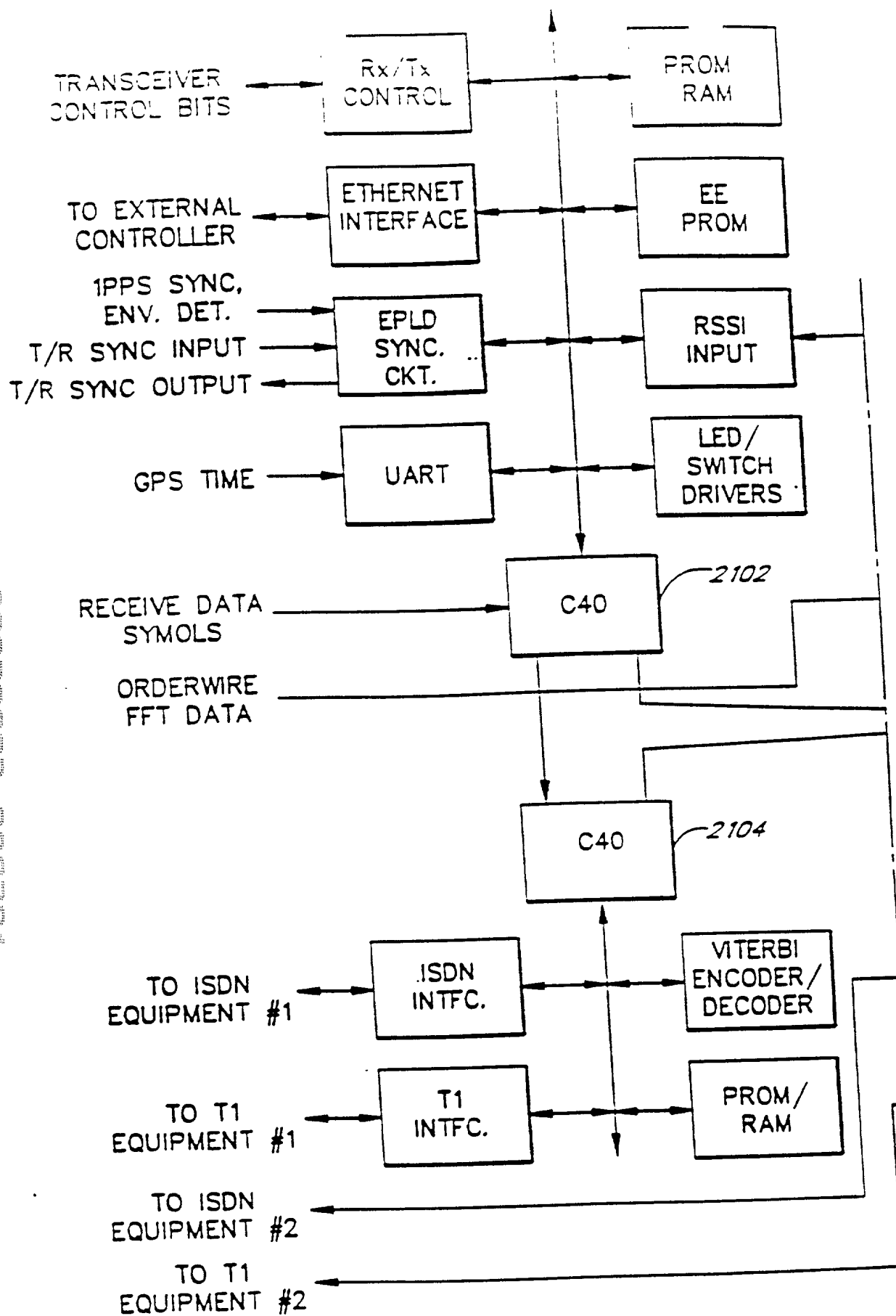


FIG. 78C

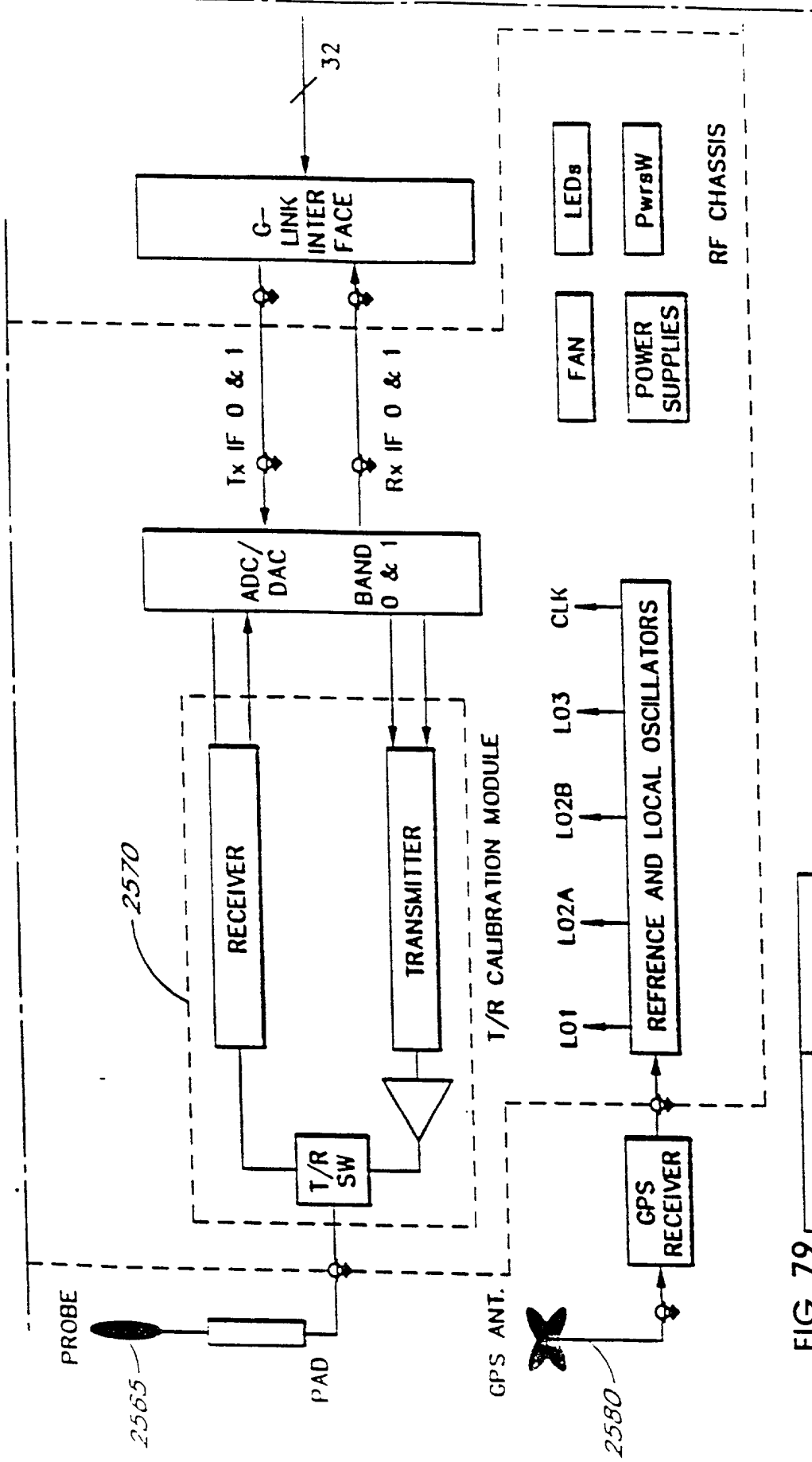


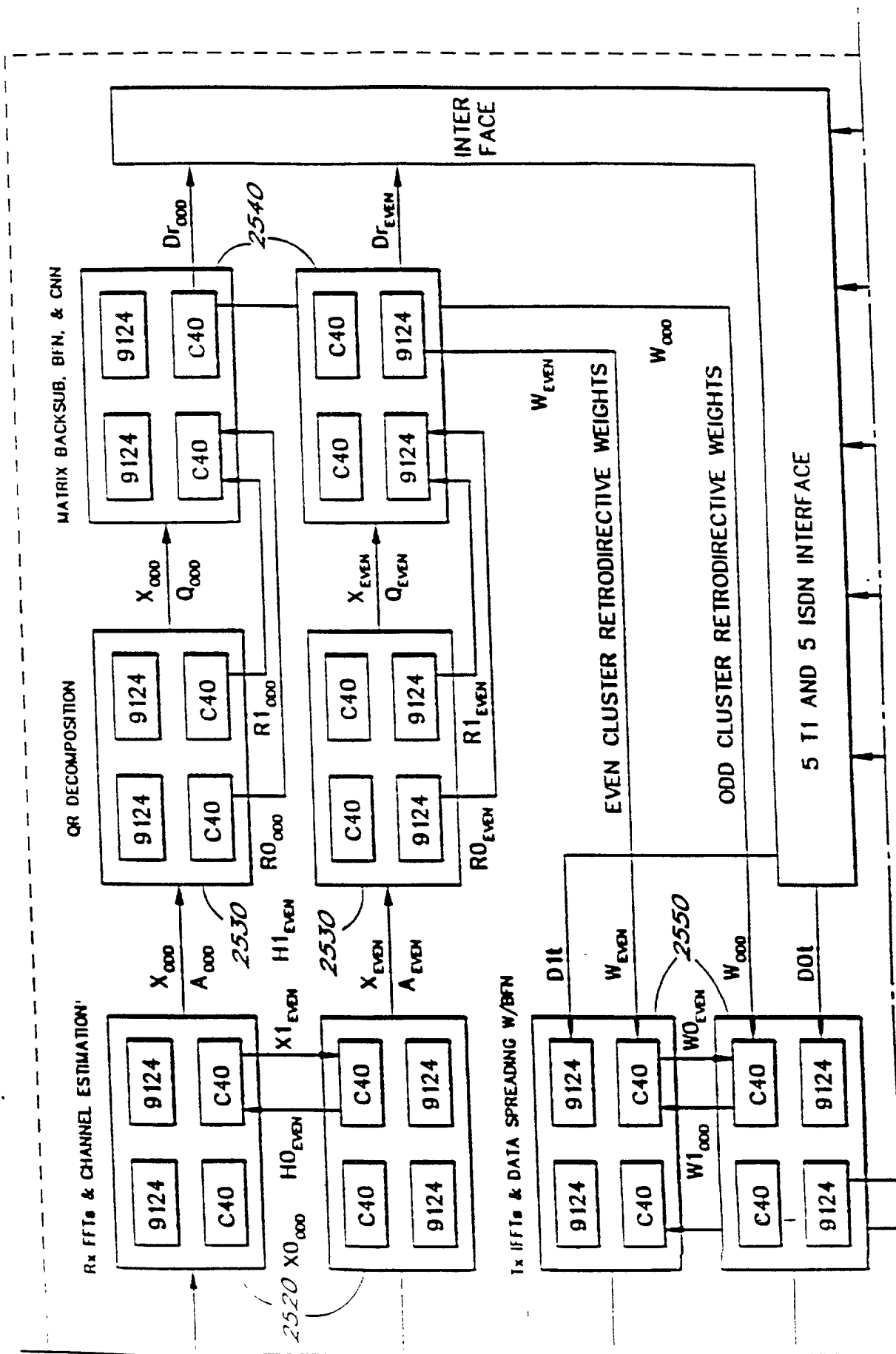
FIG. 79A

FIG. 79

FIG. 79B	FIG. 79C
FIG. 79A	FIG. 79D



FIG. 79C



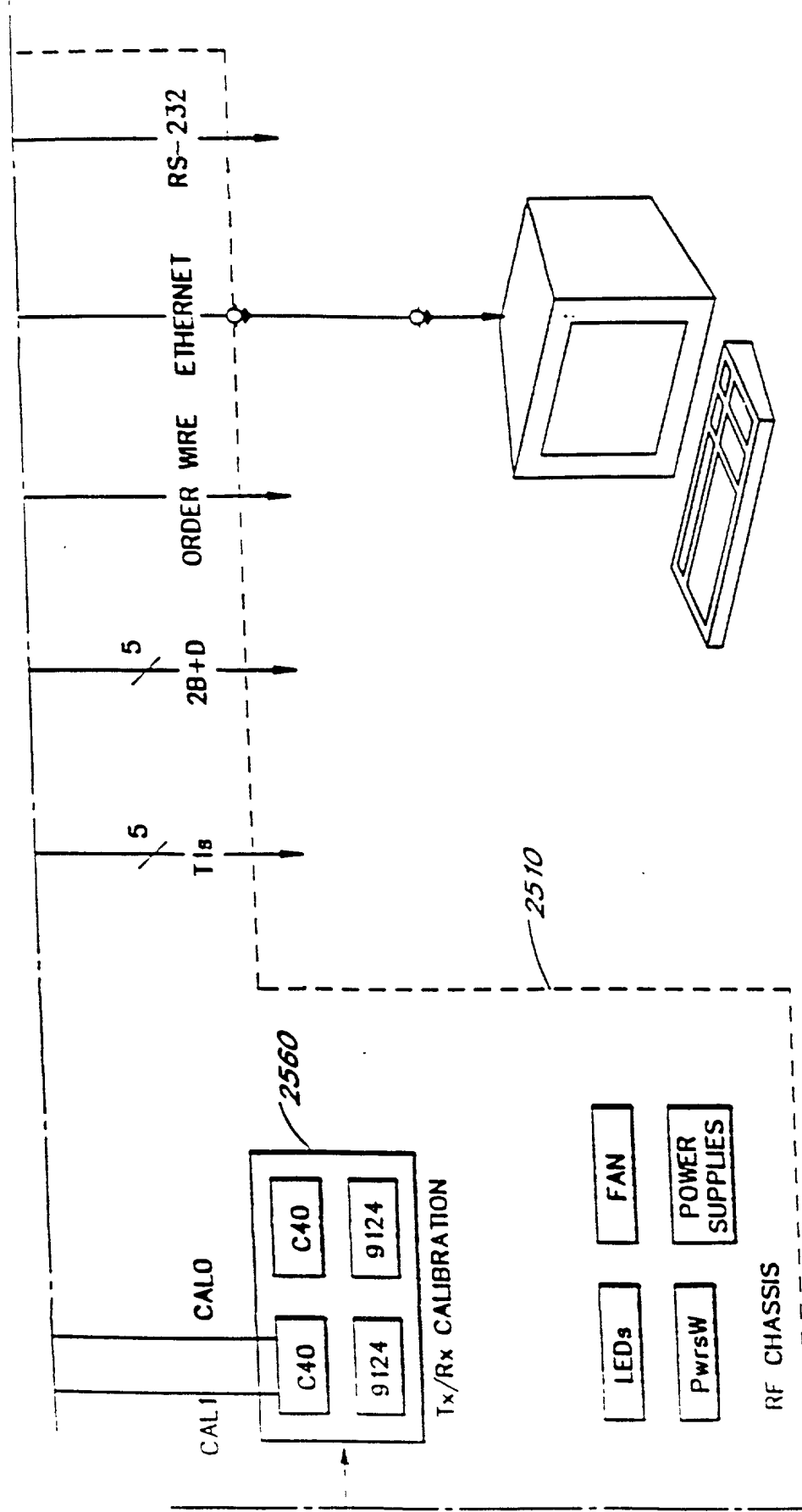
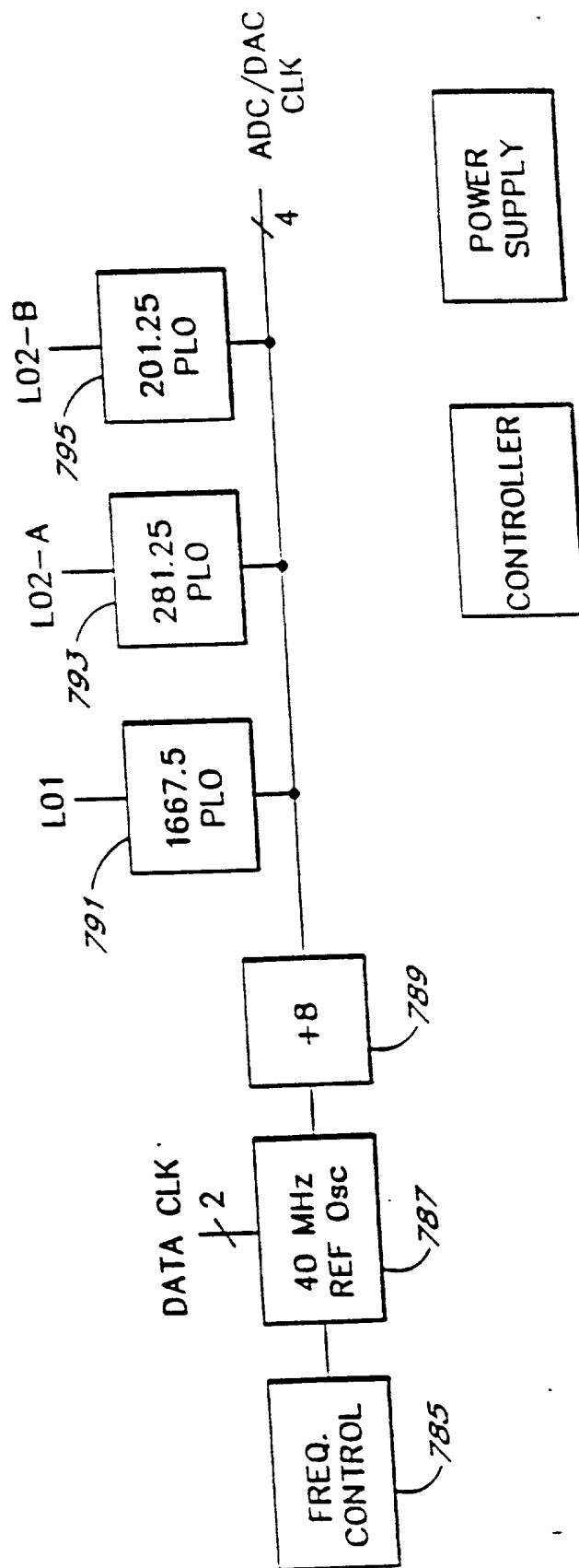


FIG. 79D

FIG. 80A



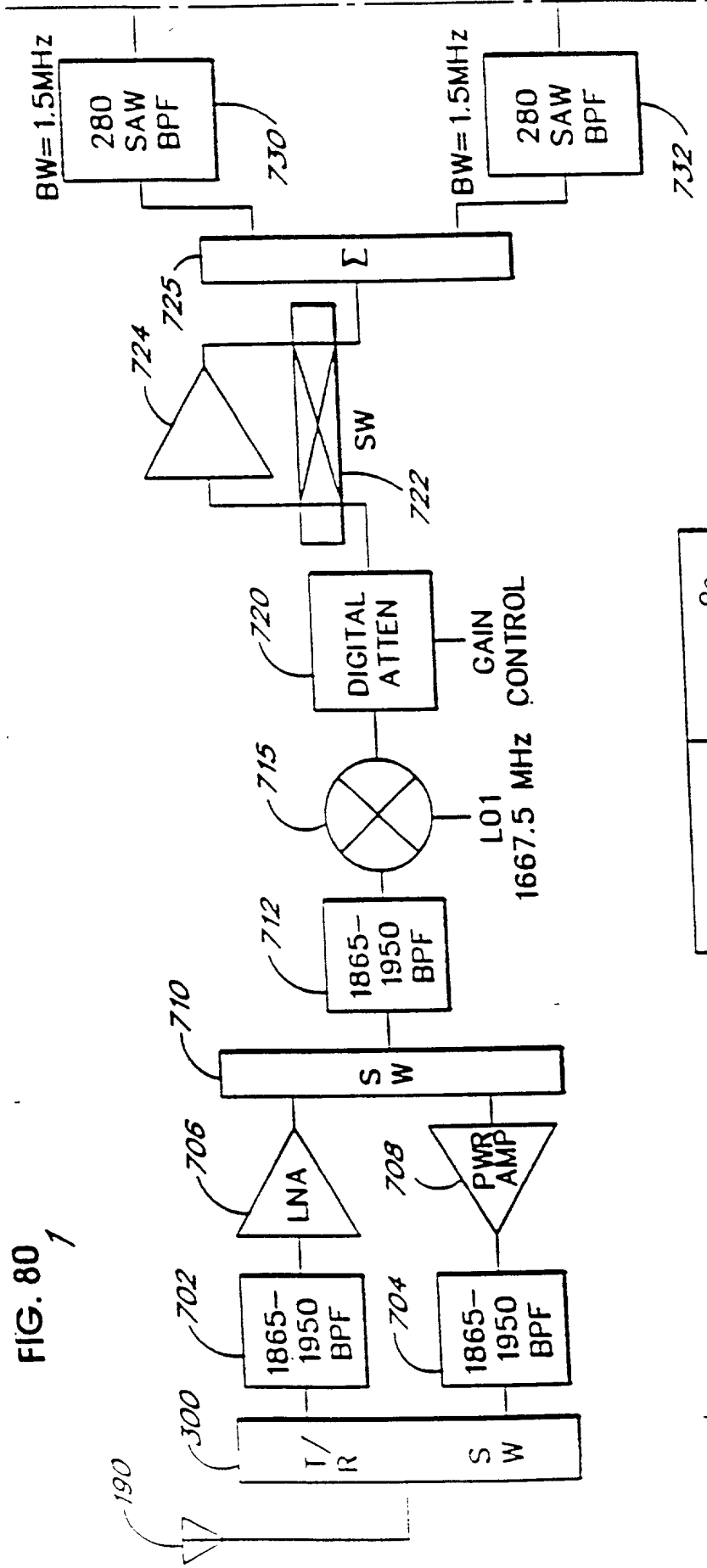


FIG. 80

FIG. 80

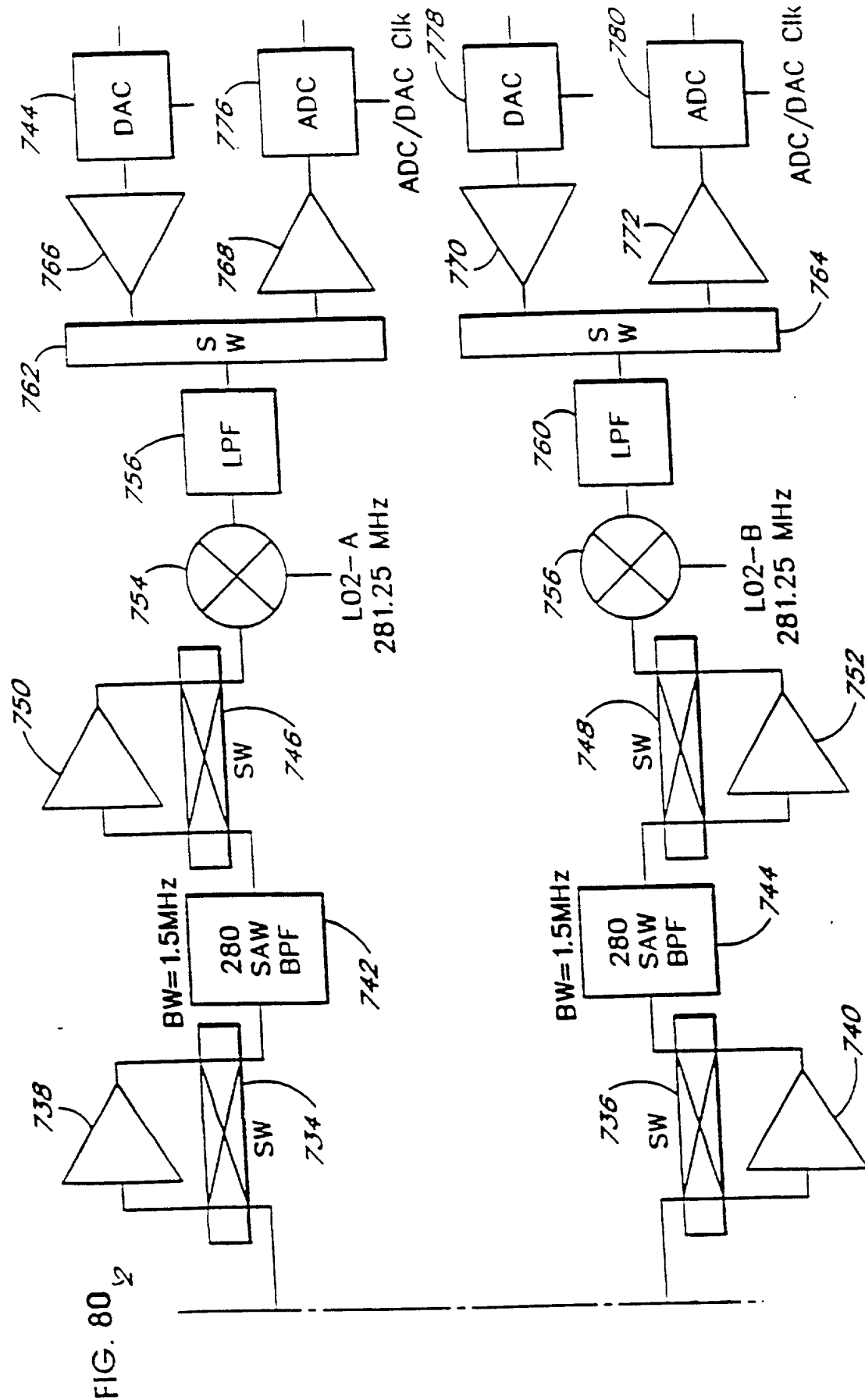


FIG. 81,

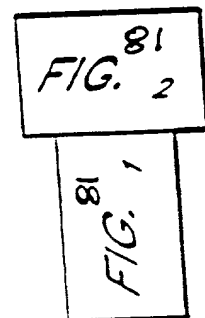
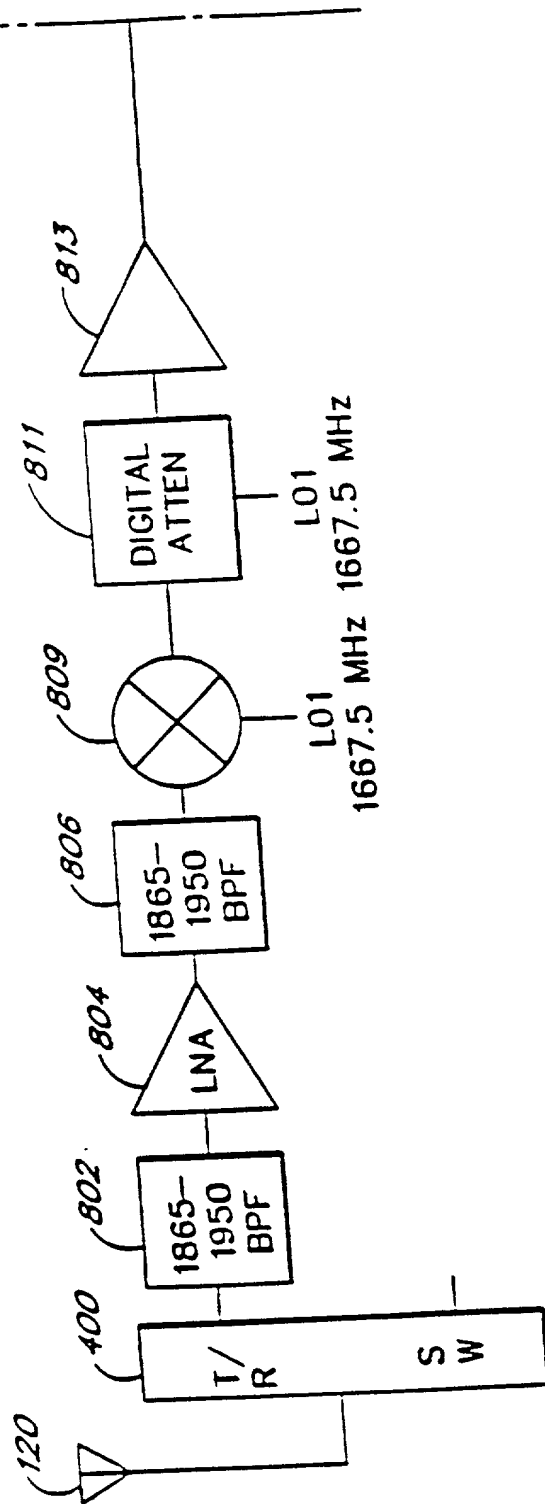


FIG. 81

FIG. 81  
2

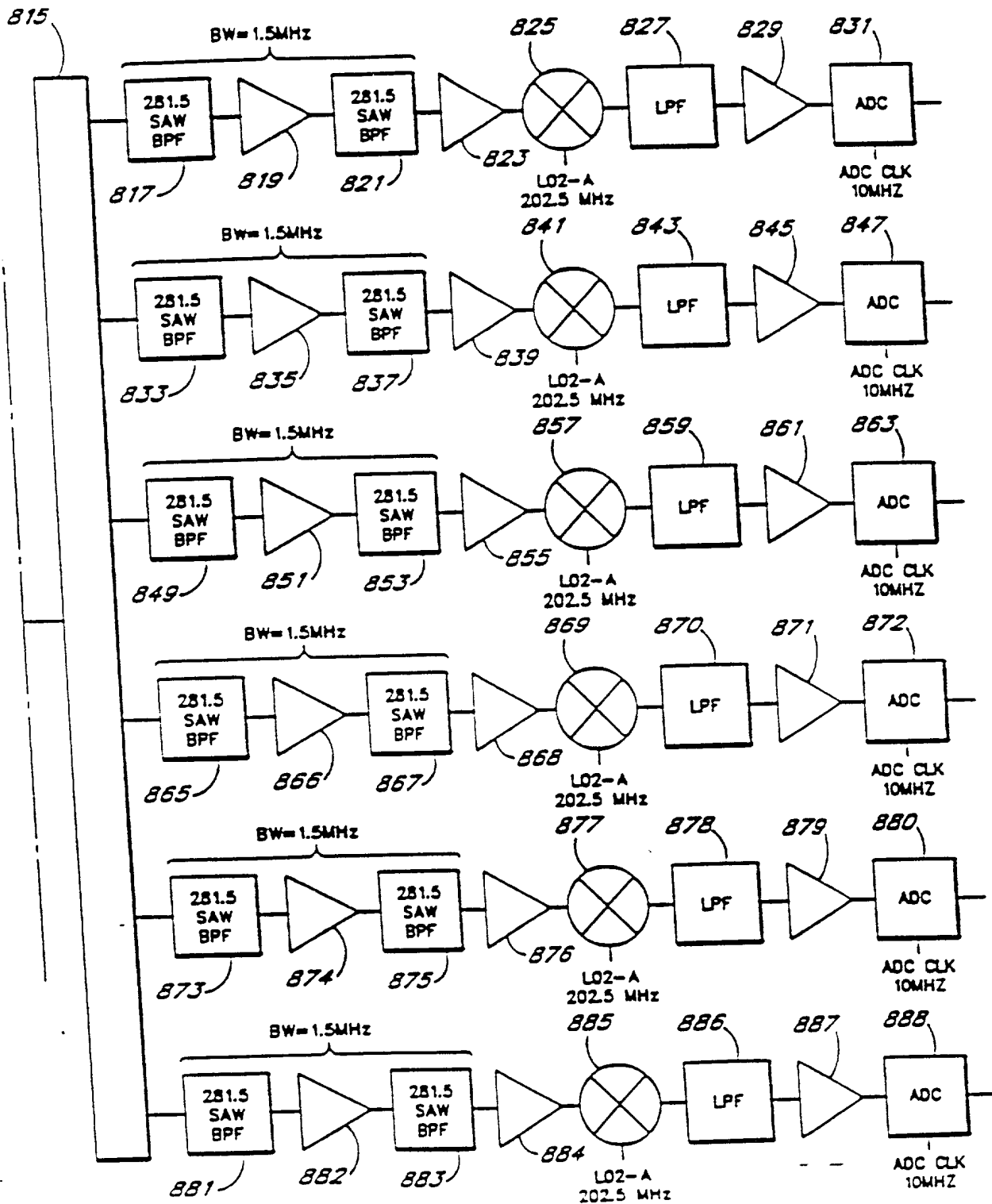


FIG. 81A

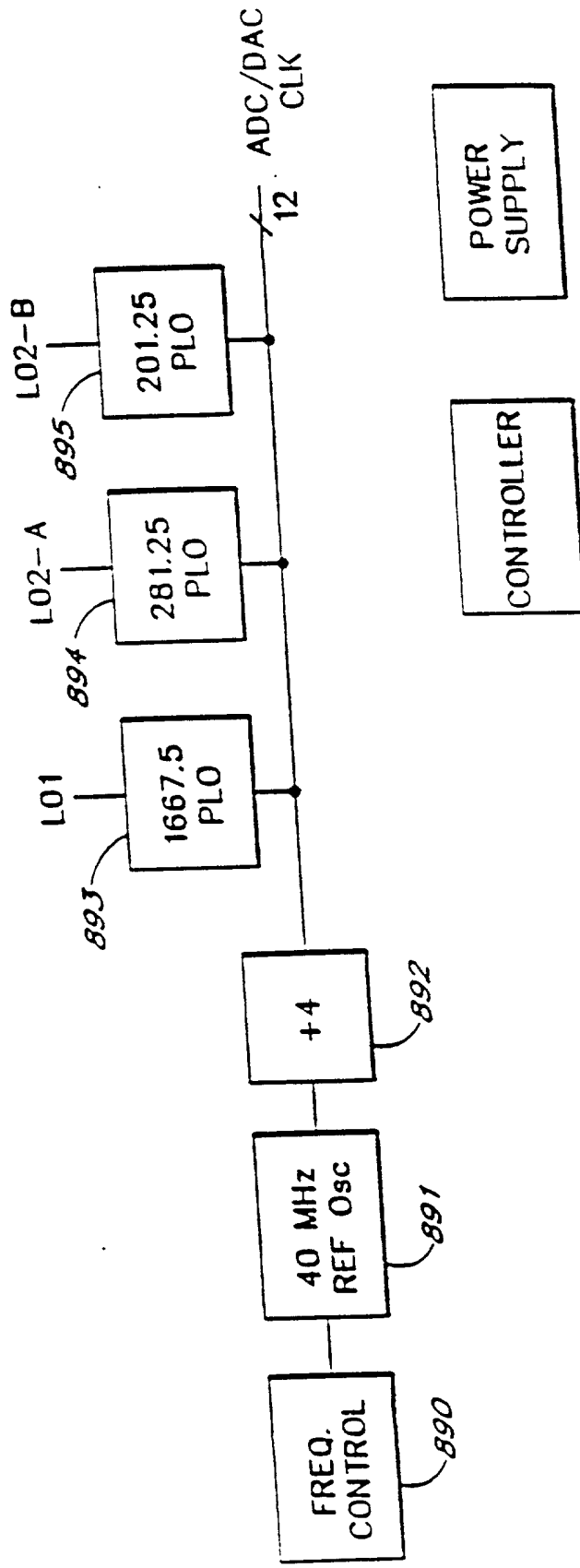


FIG. 82

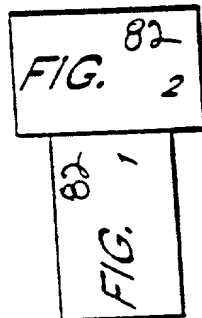
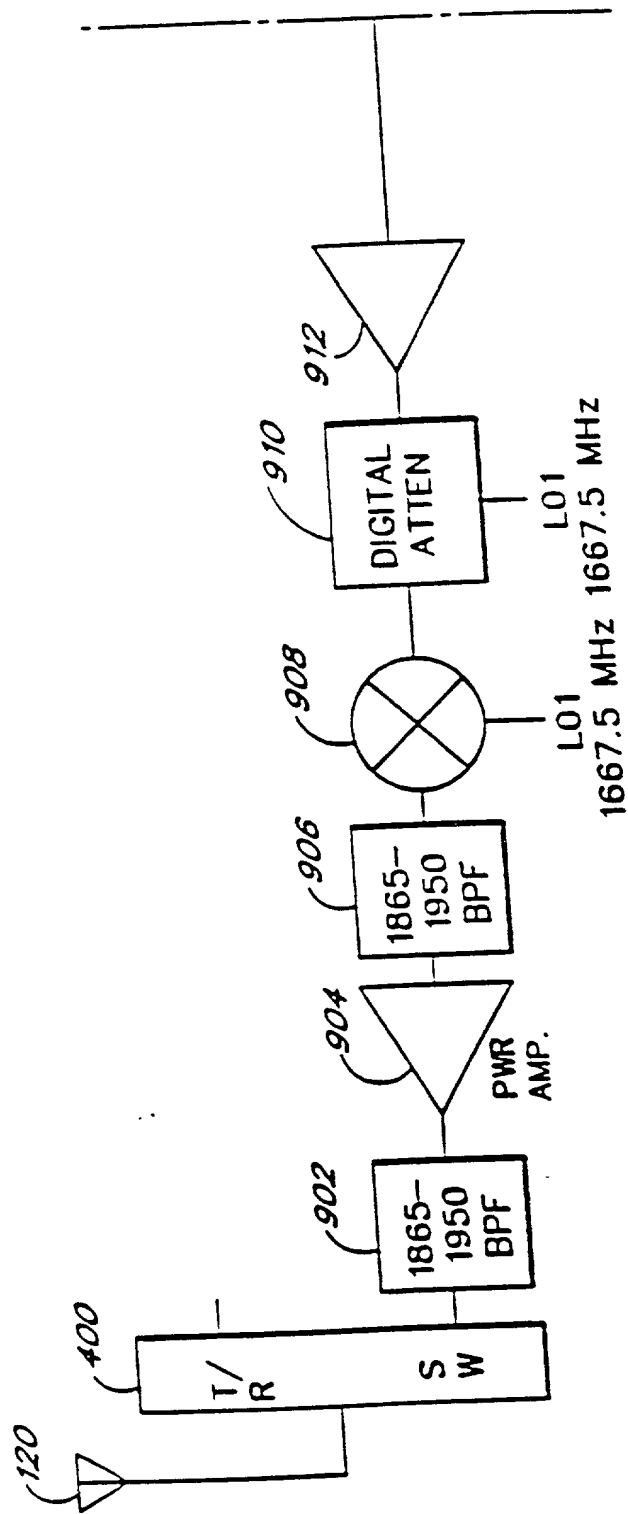
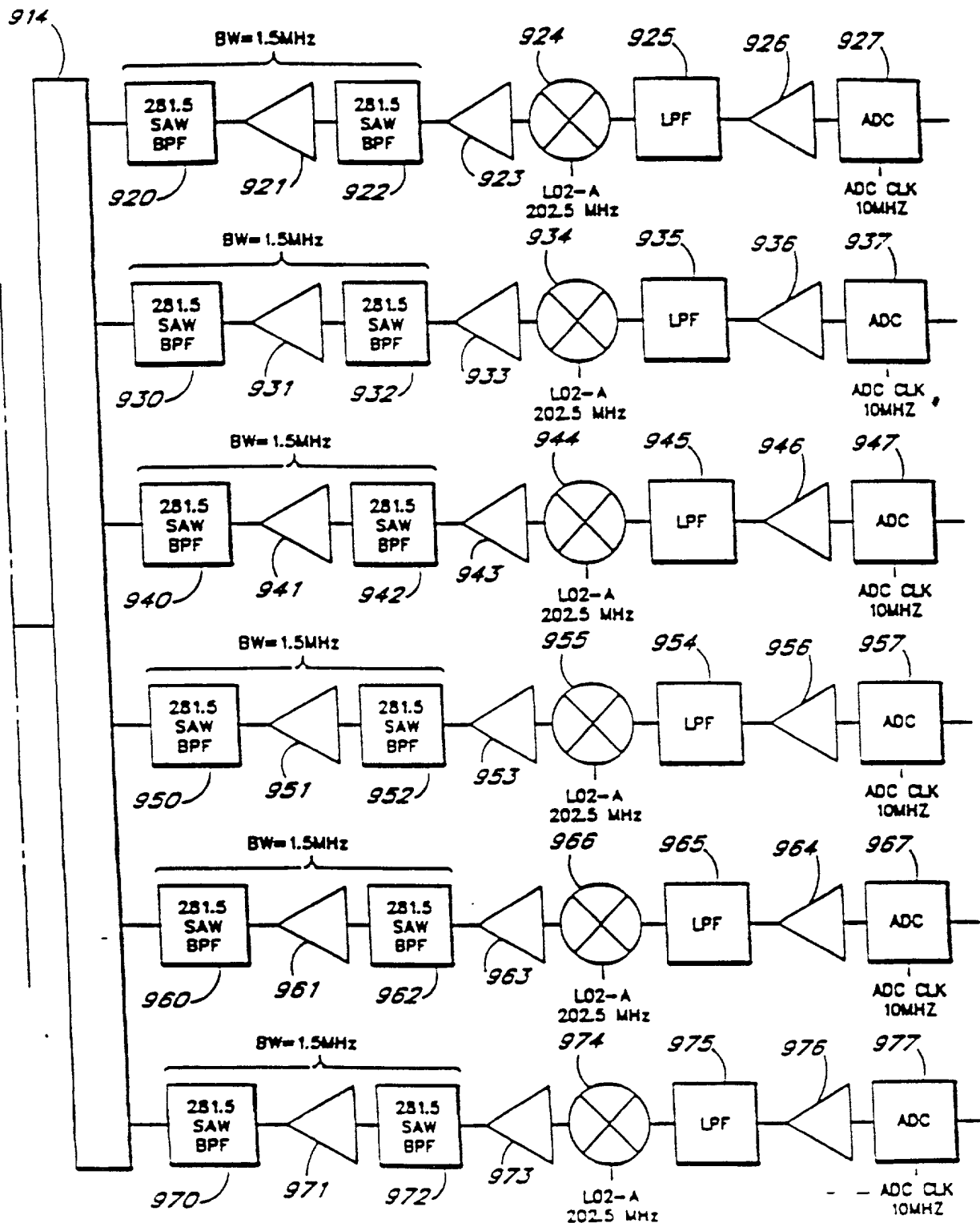
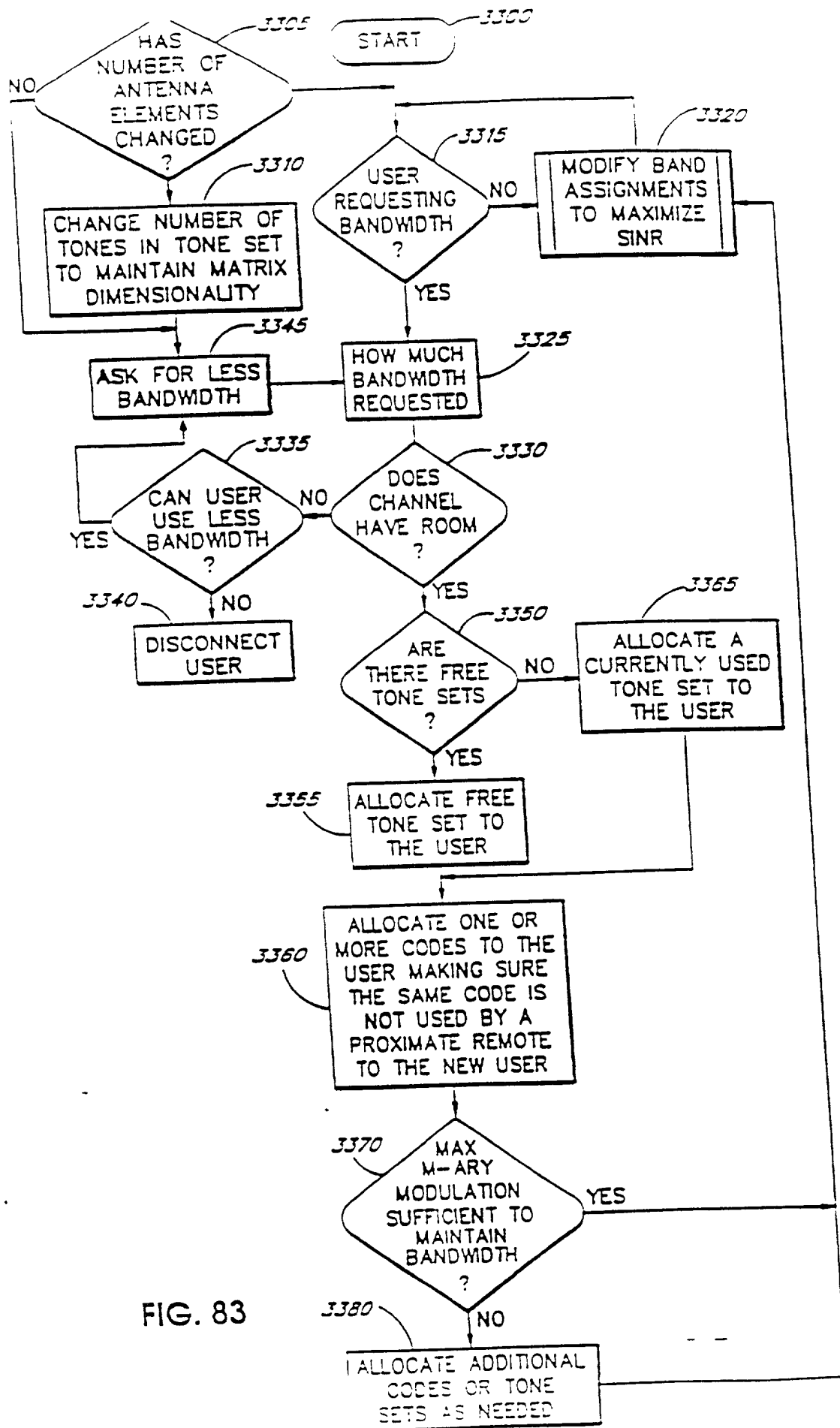


FIG. 82

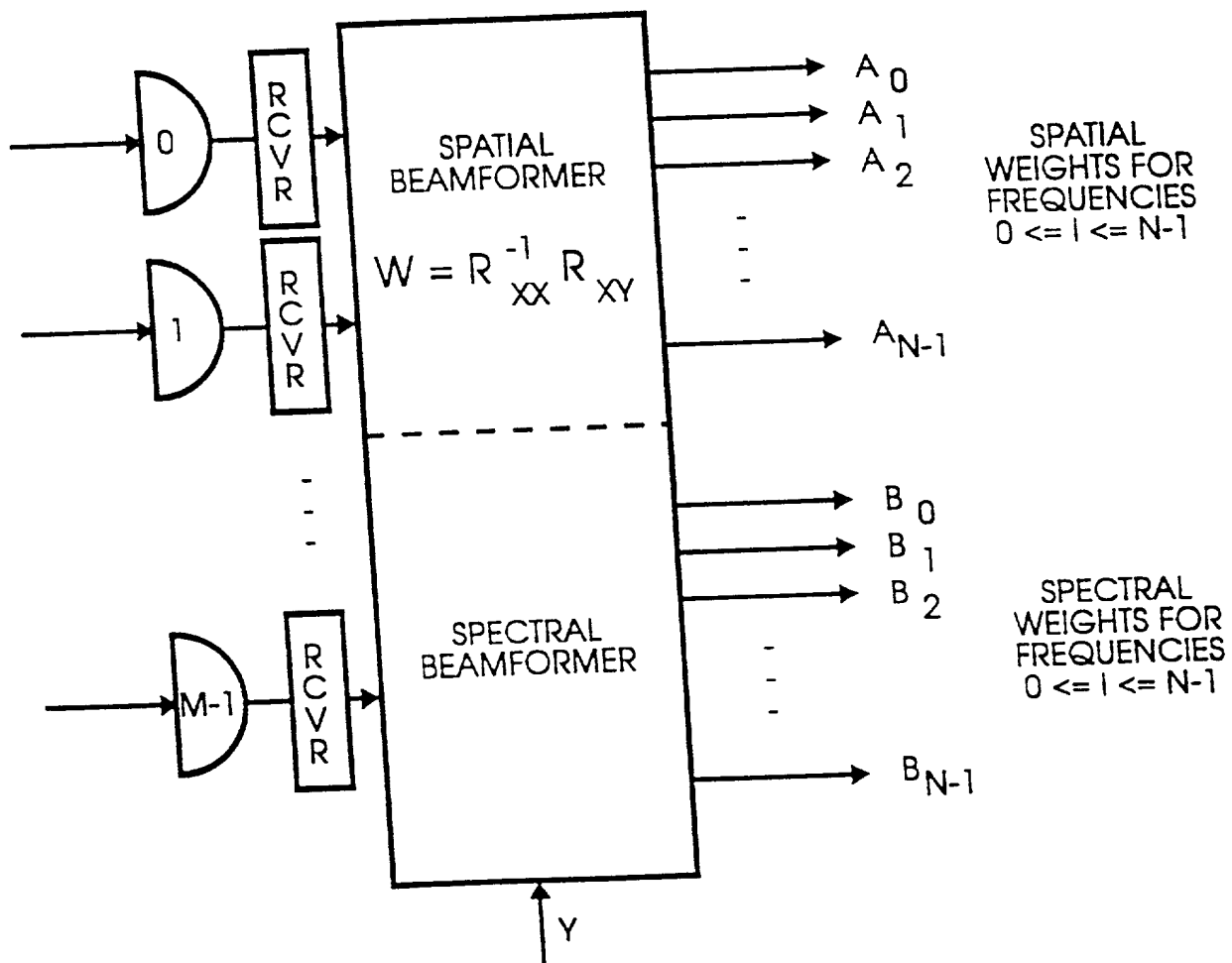
FIG. 82<sub>2</sub>





# FIG. 84A

BASE STATION



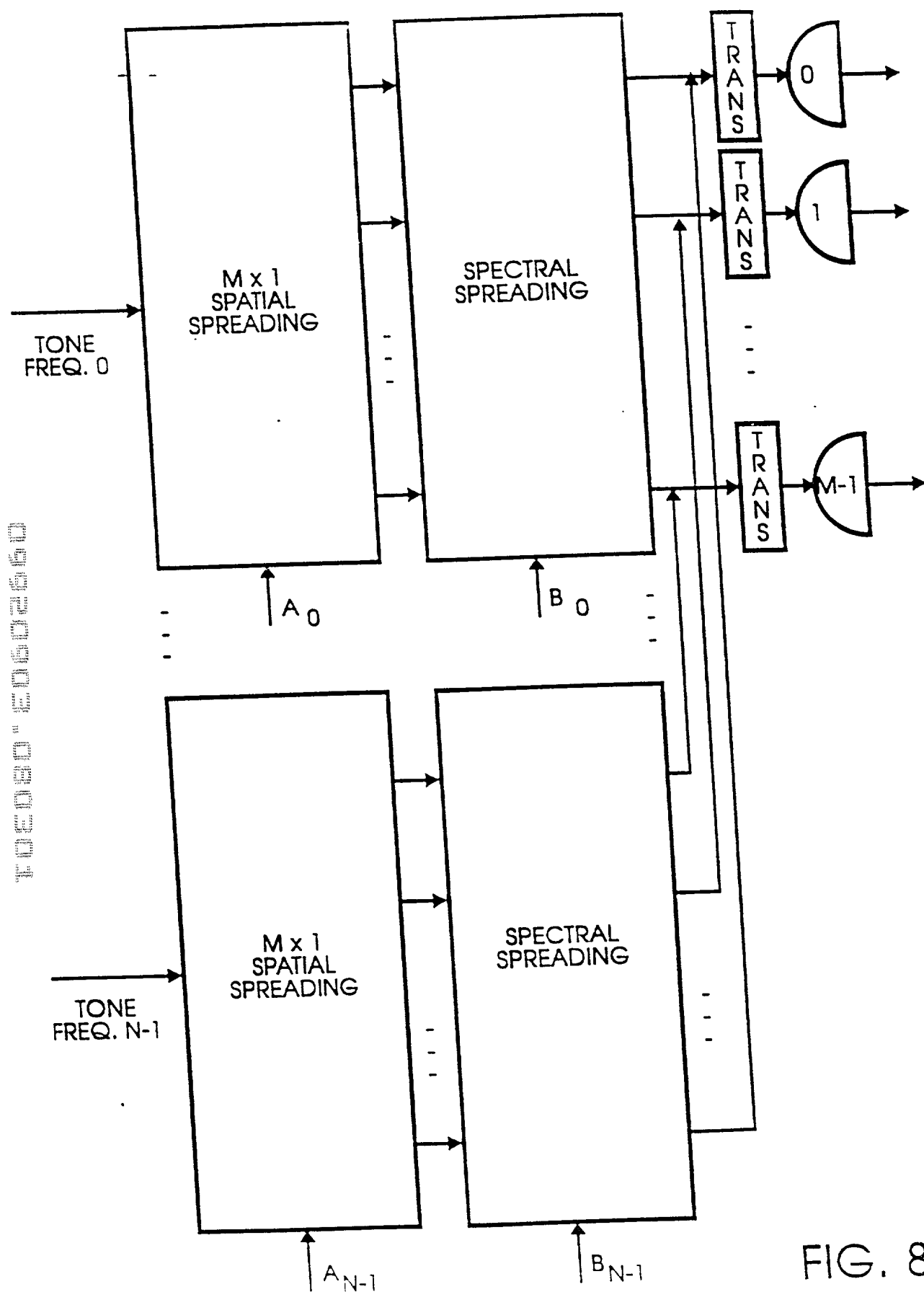


FIG. 84B

FIG. A1

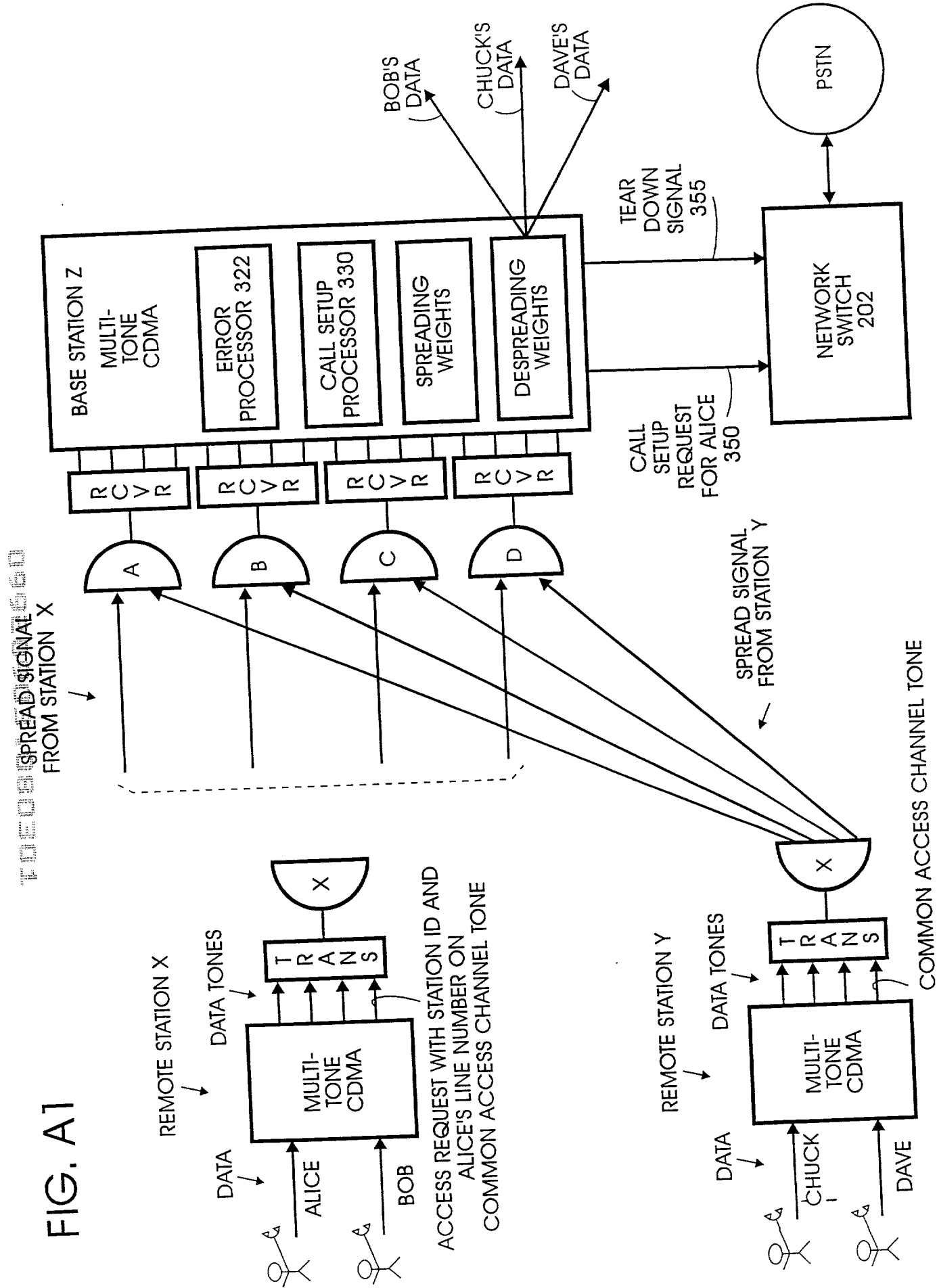


FIG. A2

FIG. A2  
BASE STATION Z

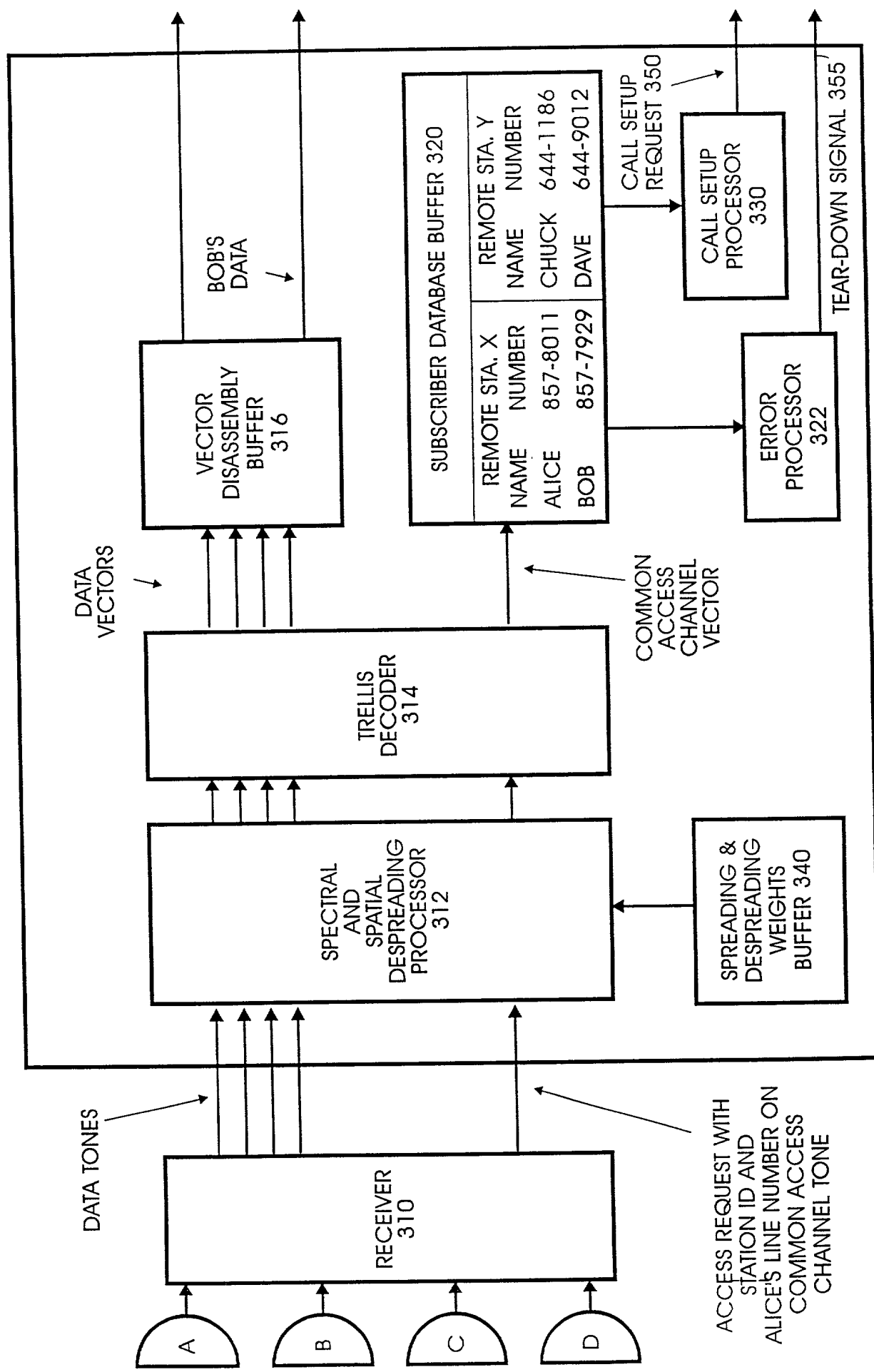
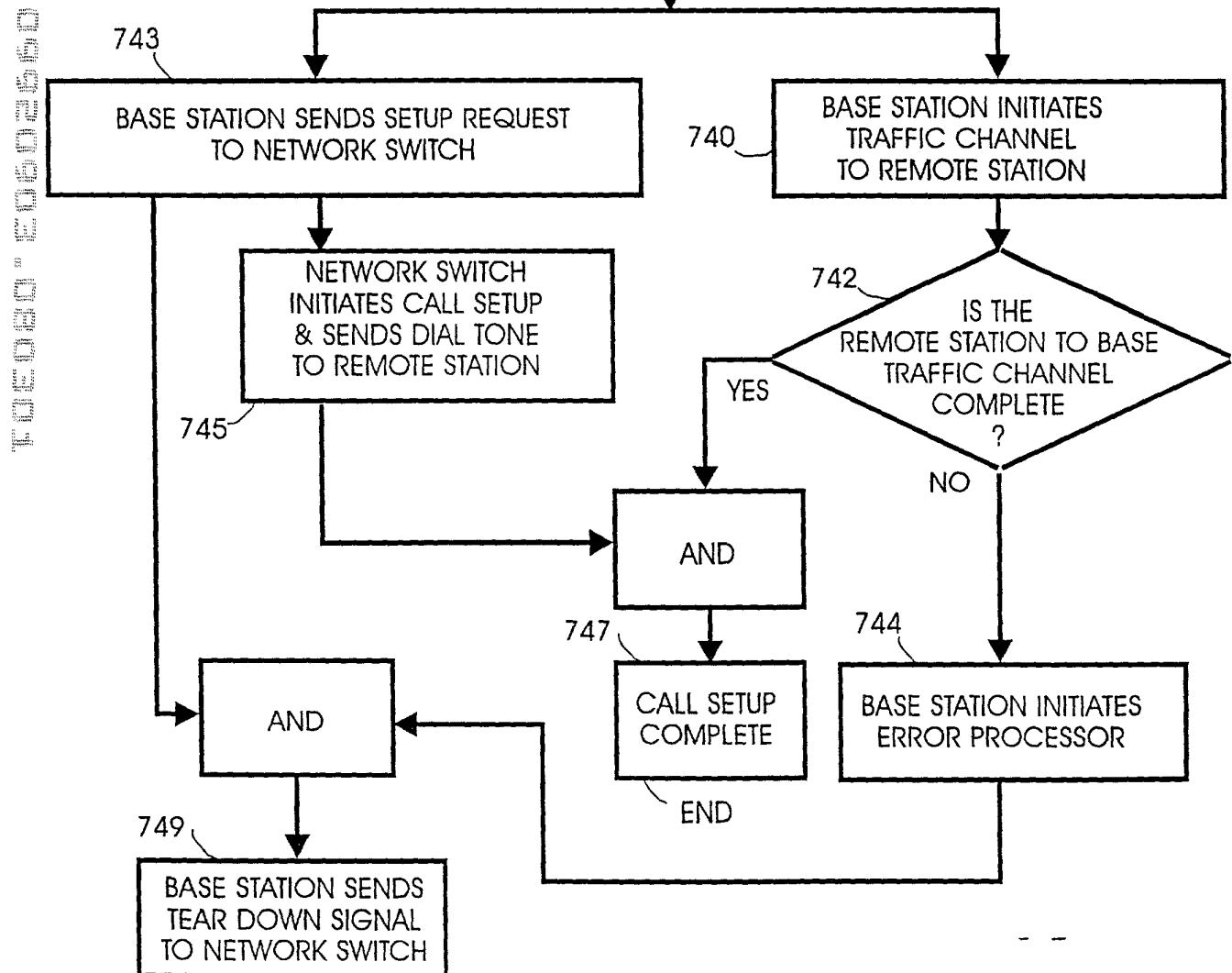


FIG. A3

700



# NO SPREAD SIGNAL FROM STATION X



FIG. B2

FIG. B2

REMOTE STATION X

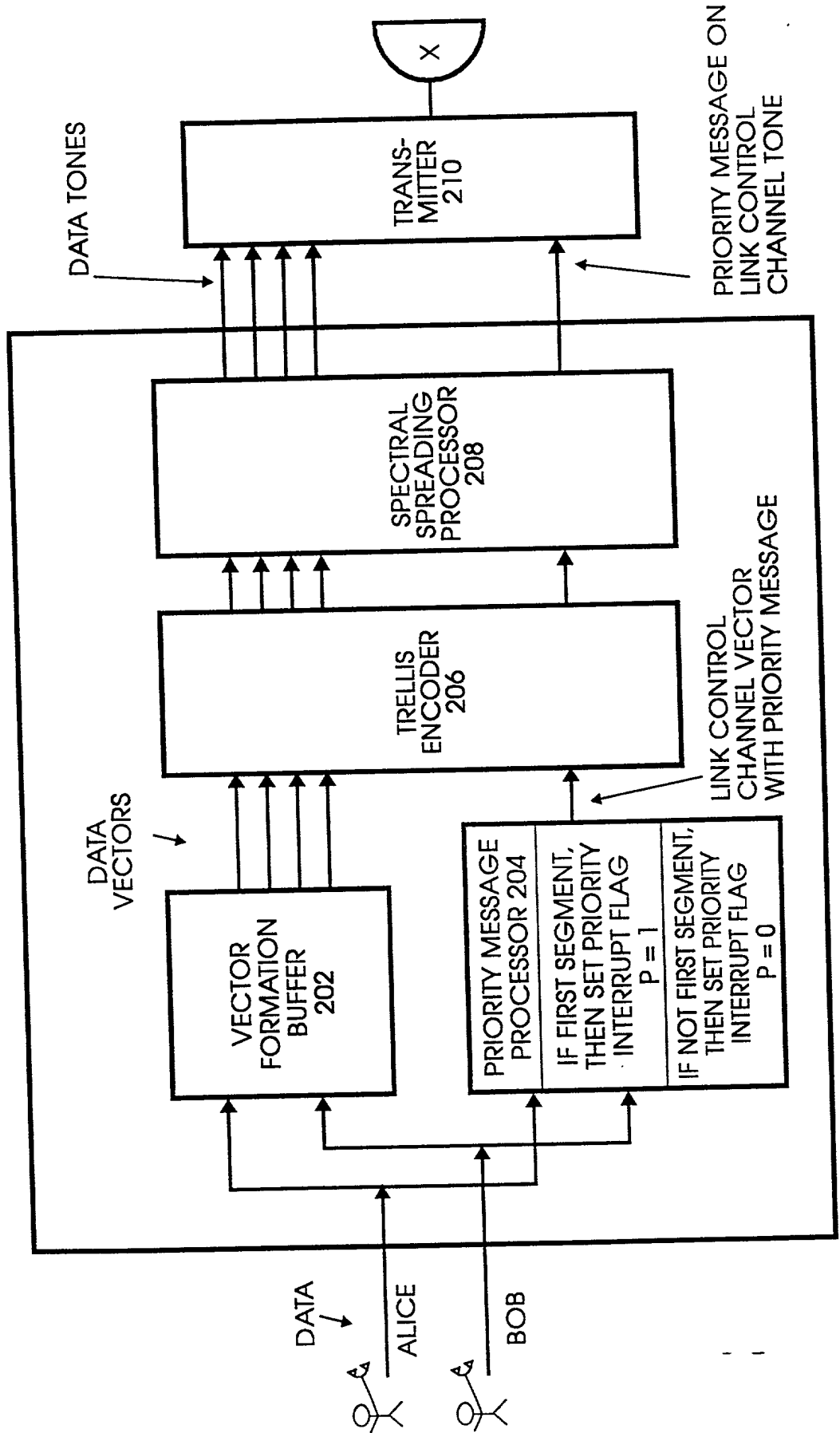


FIG. B3

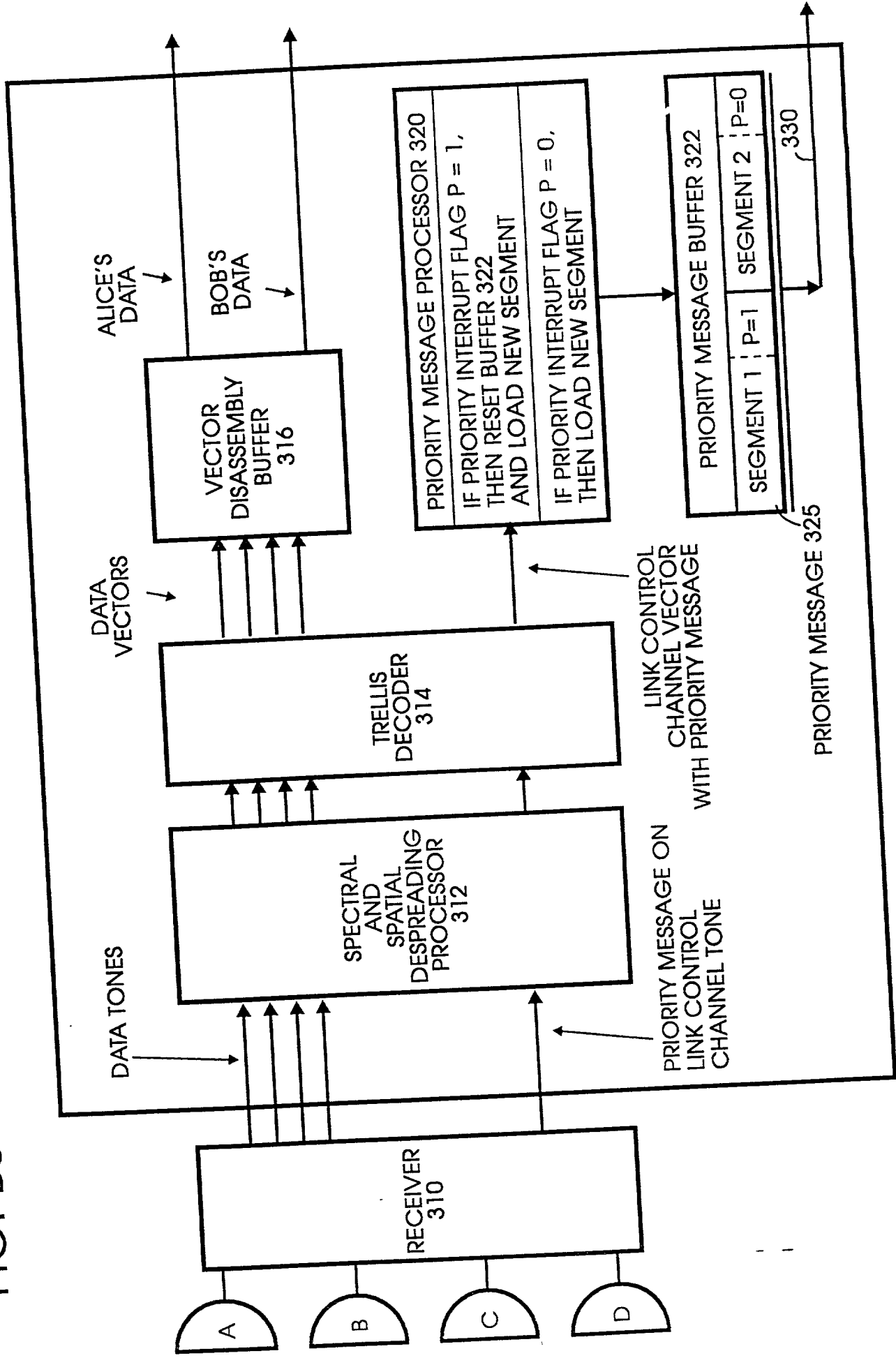


FIG. B4

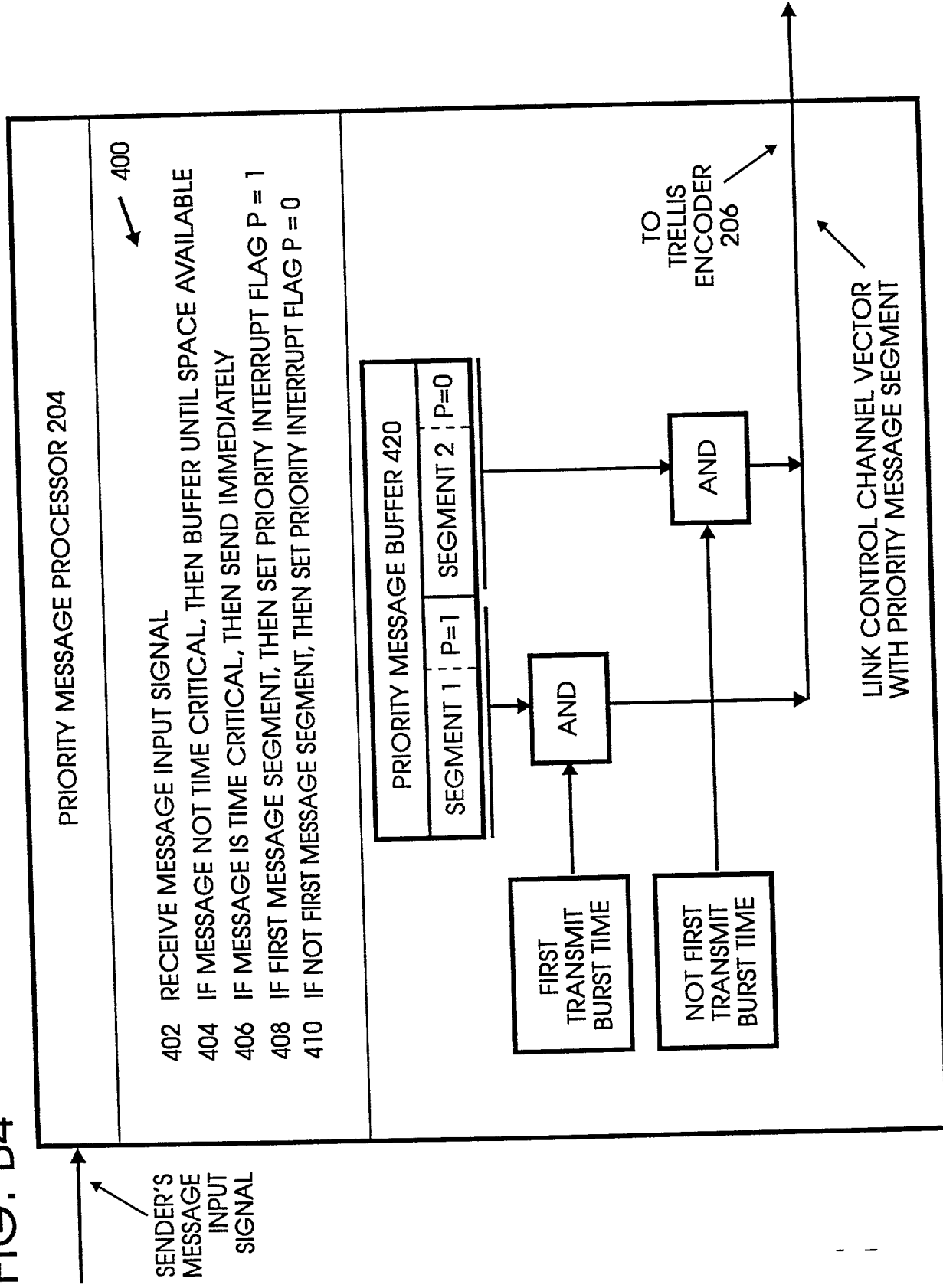


FIG. B5

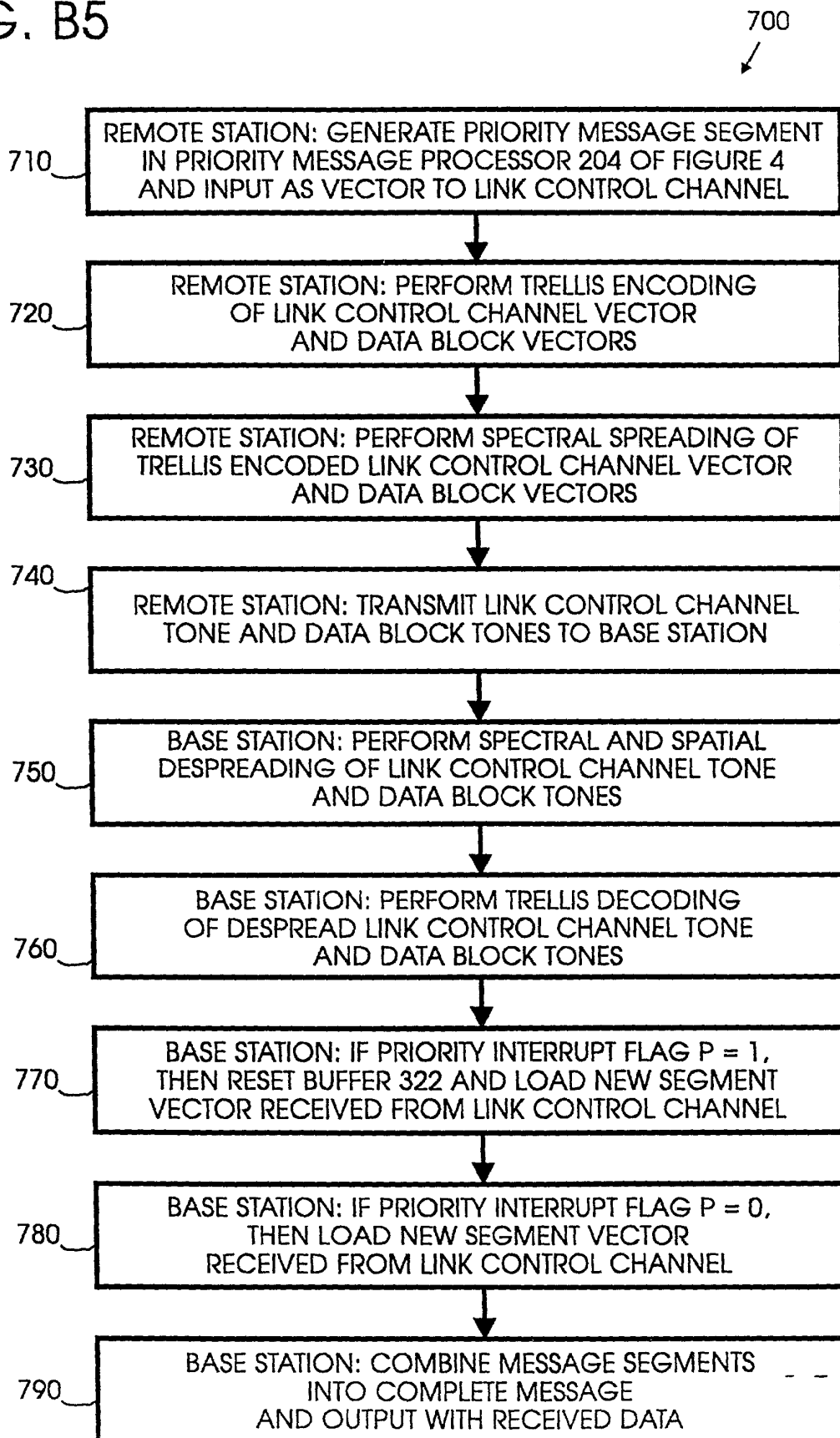


FIG. B6

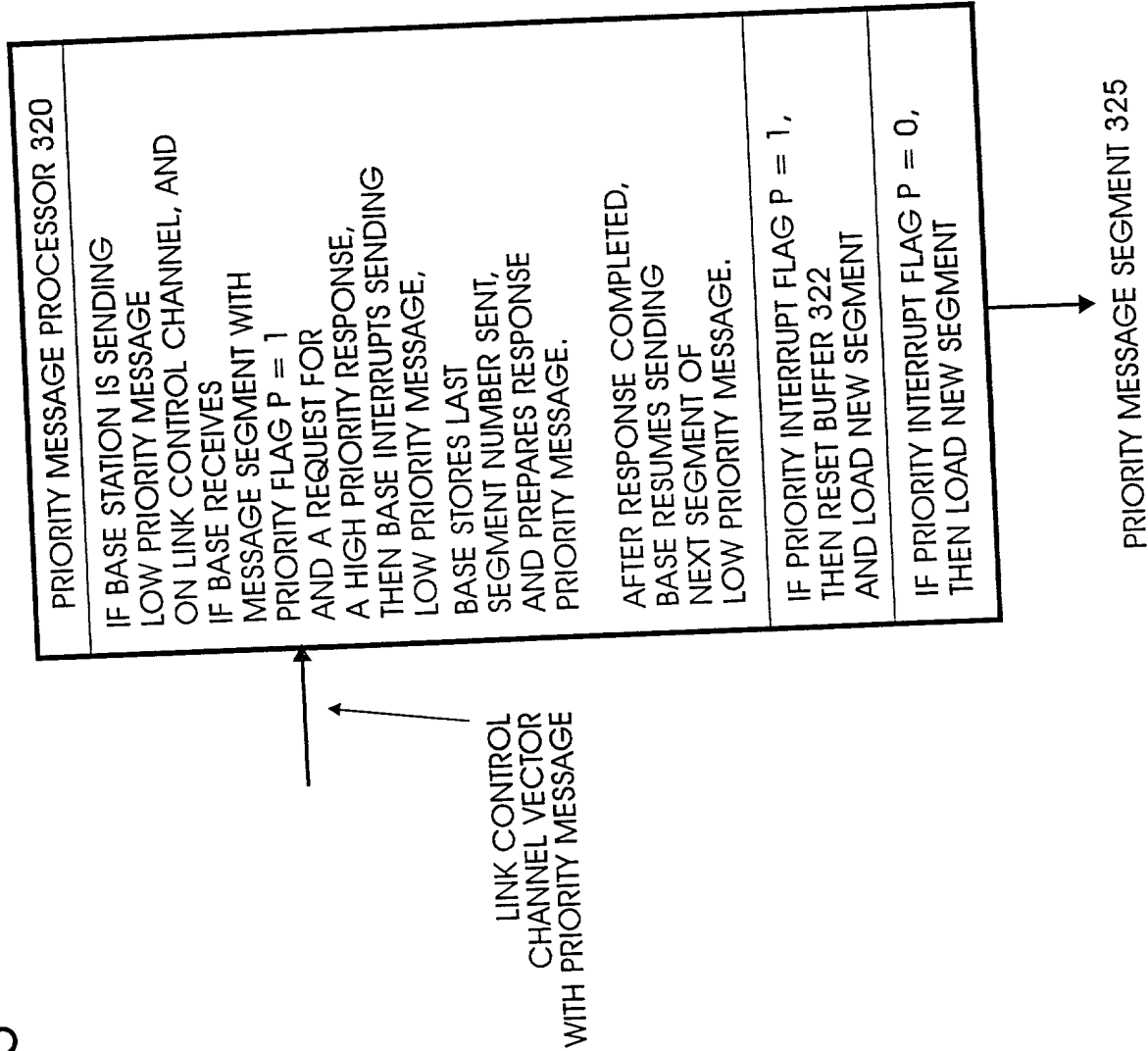


FIG. C1A

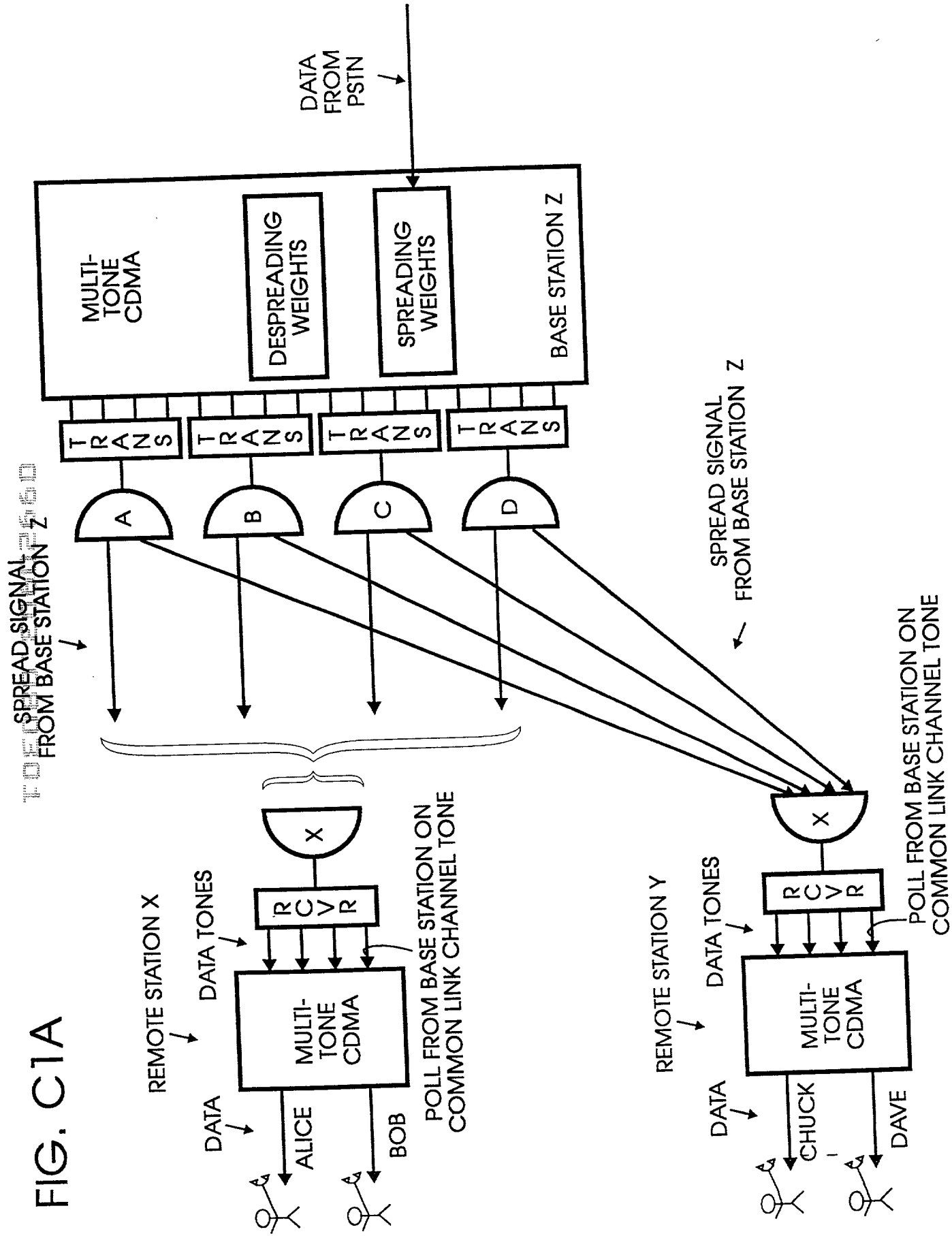


FIG. C1B

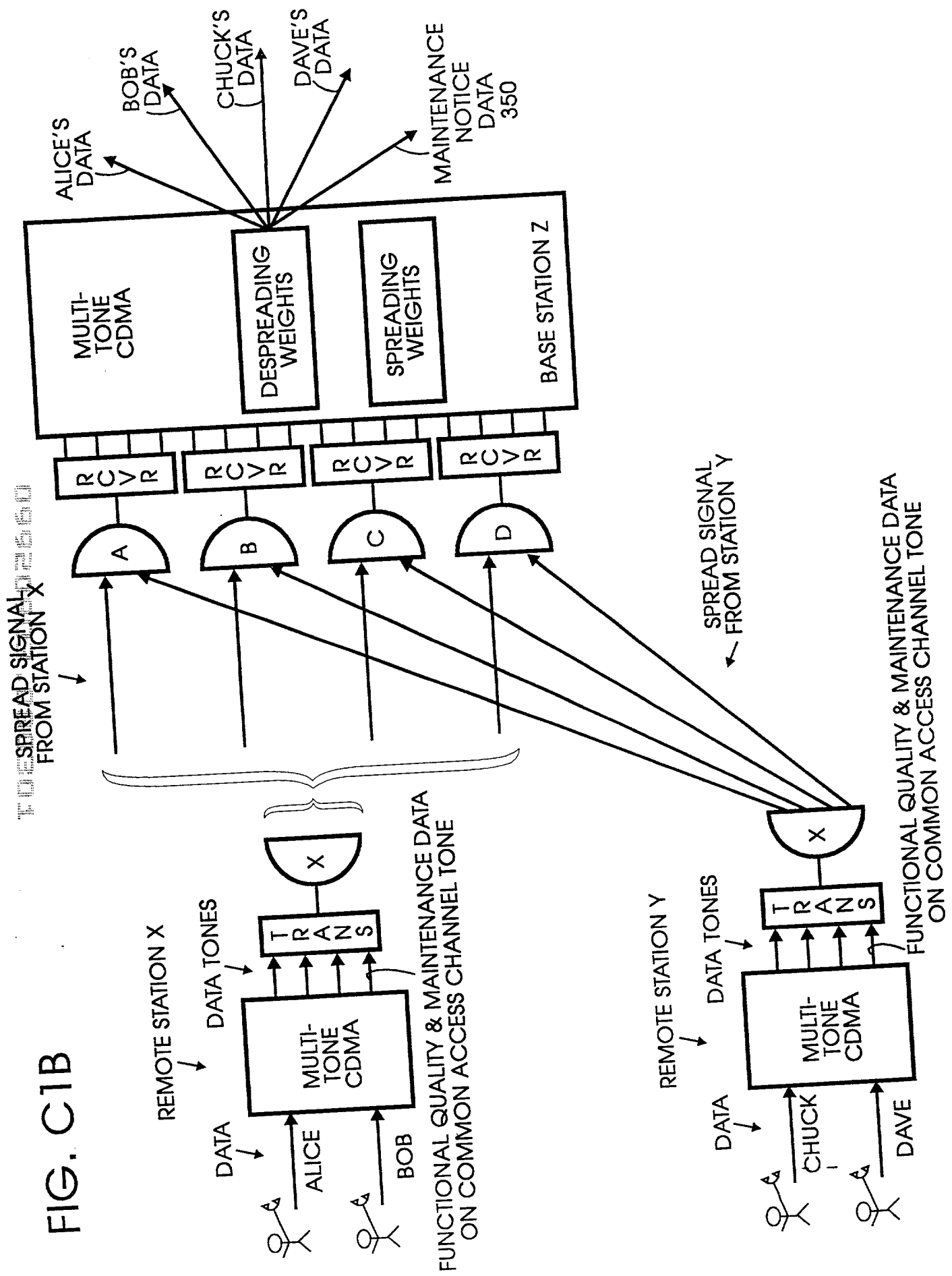


FIG. C2

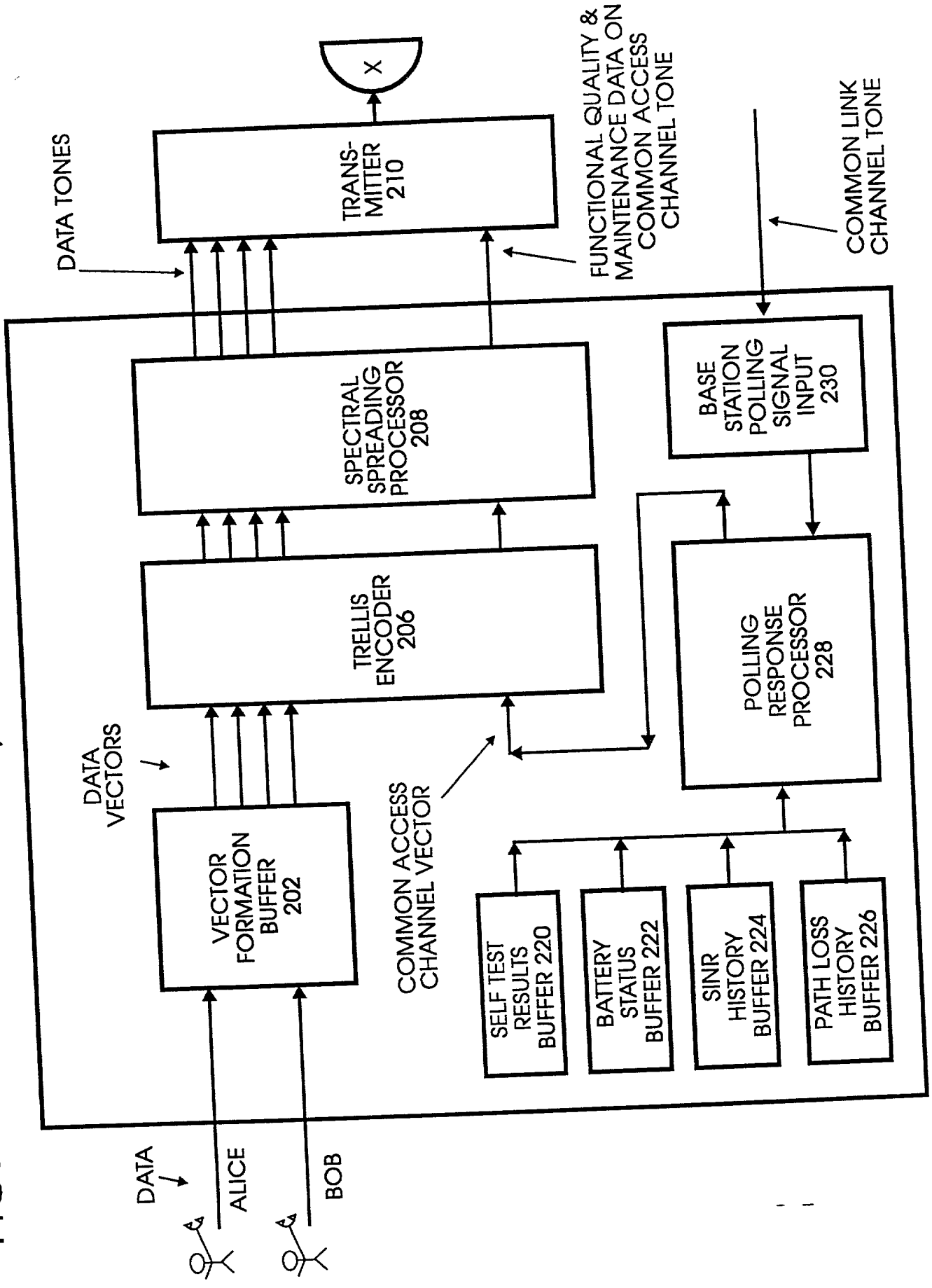


FIG. C3

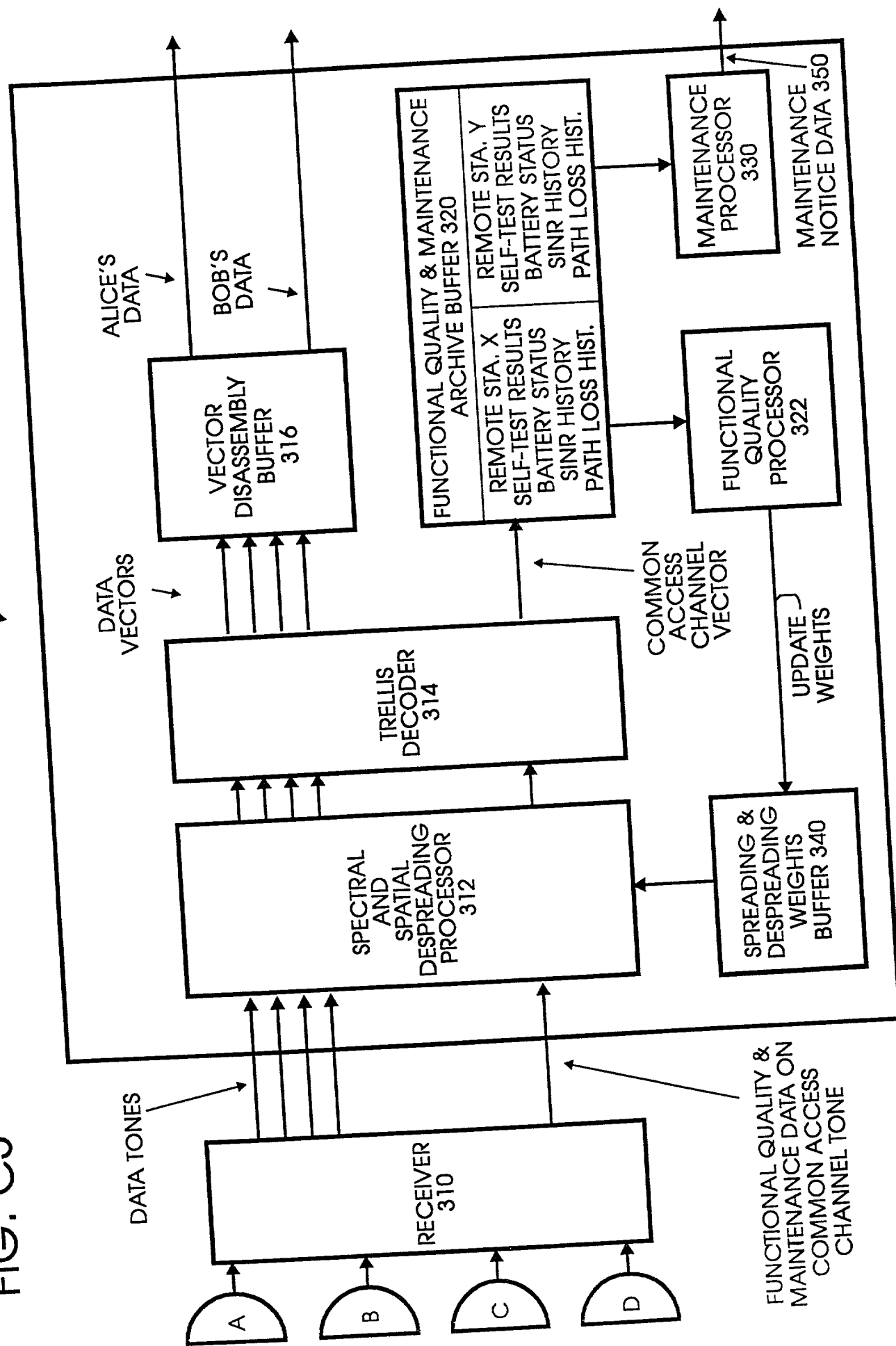


FIG. C4

700

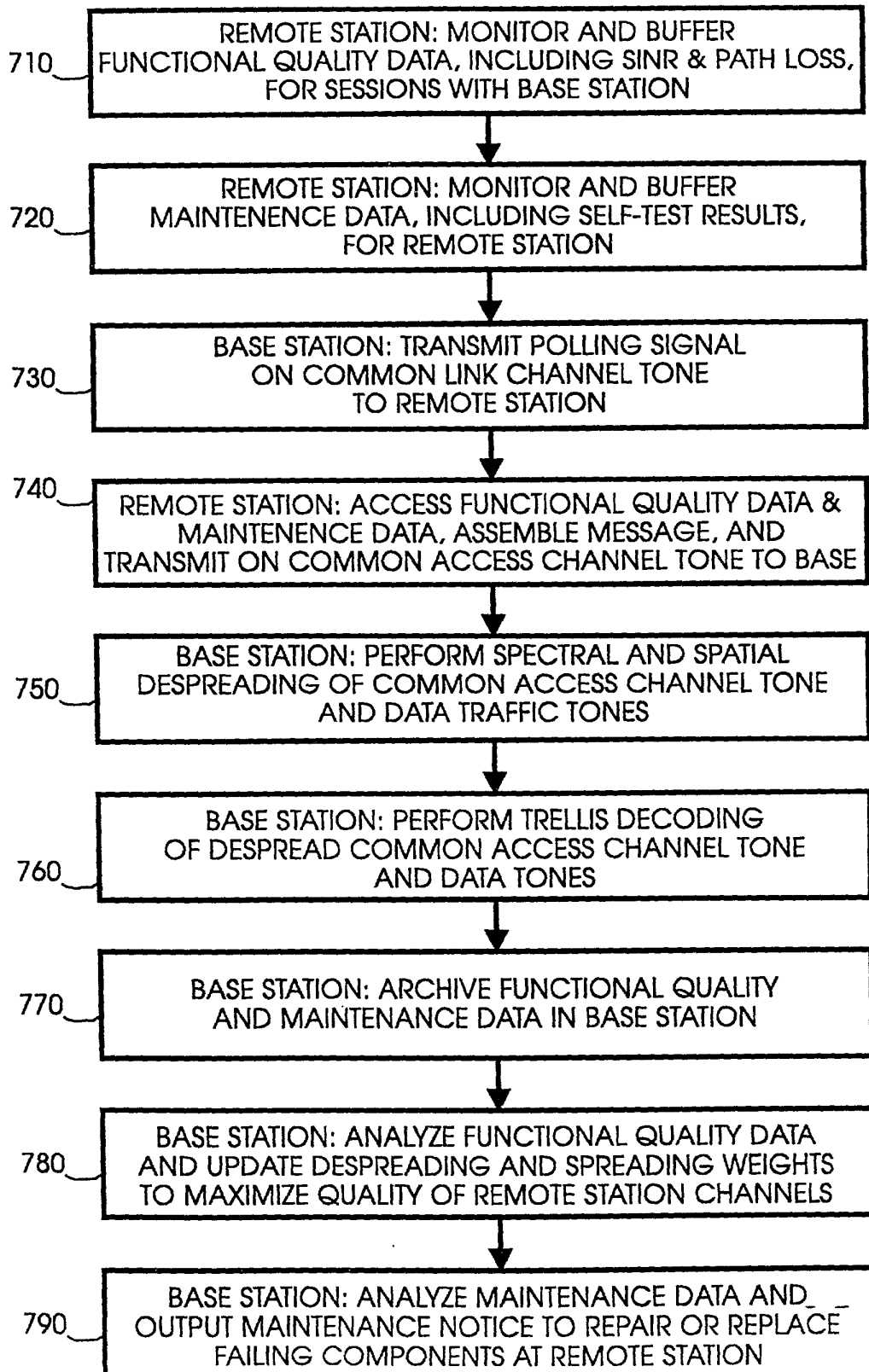


FIG. C4

FIG. 1

SPREAD SIGNAL  
FROM BASE STATION Z

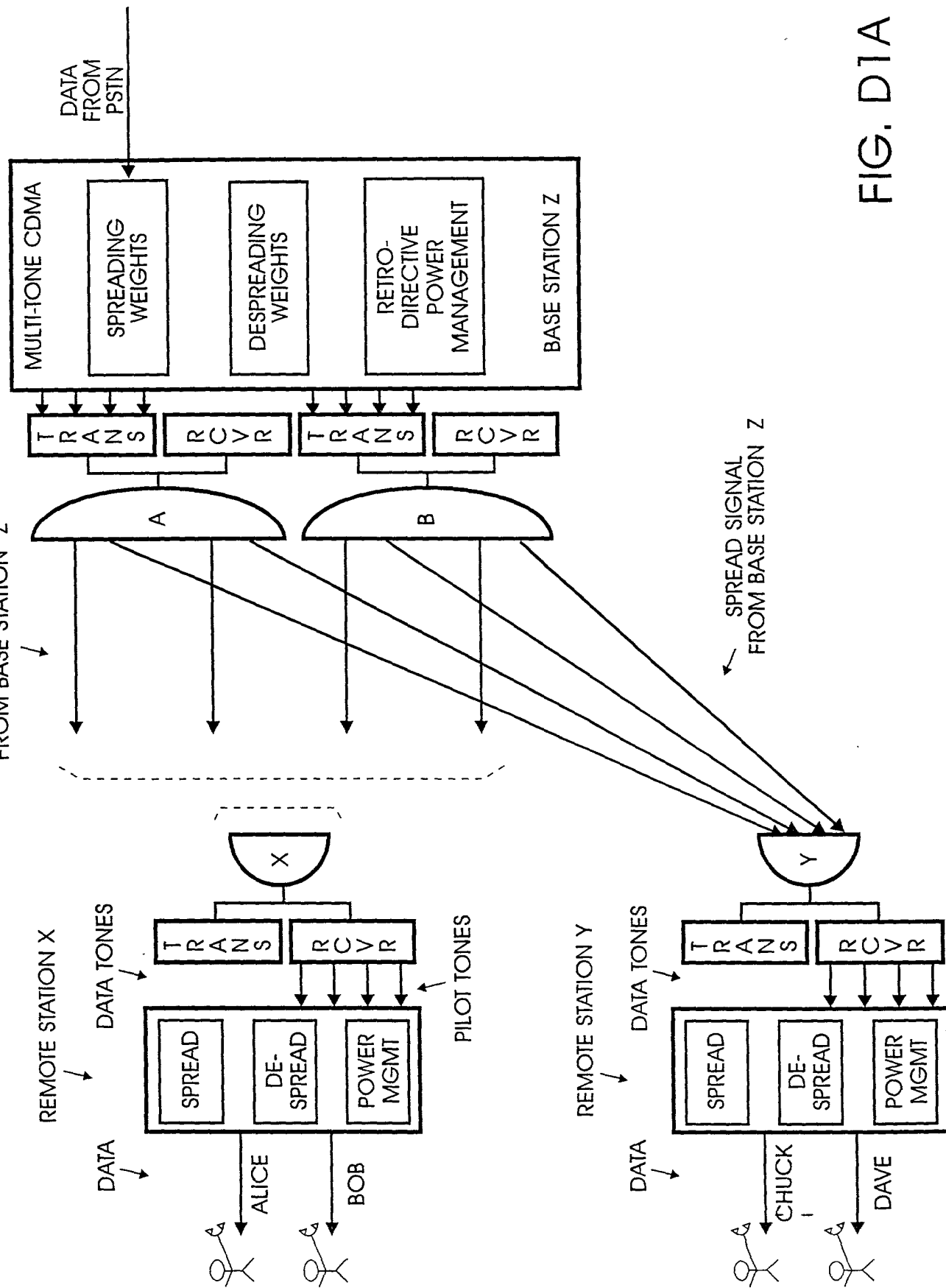


FIG. D1A

FIG. D1B

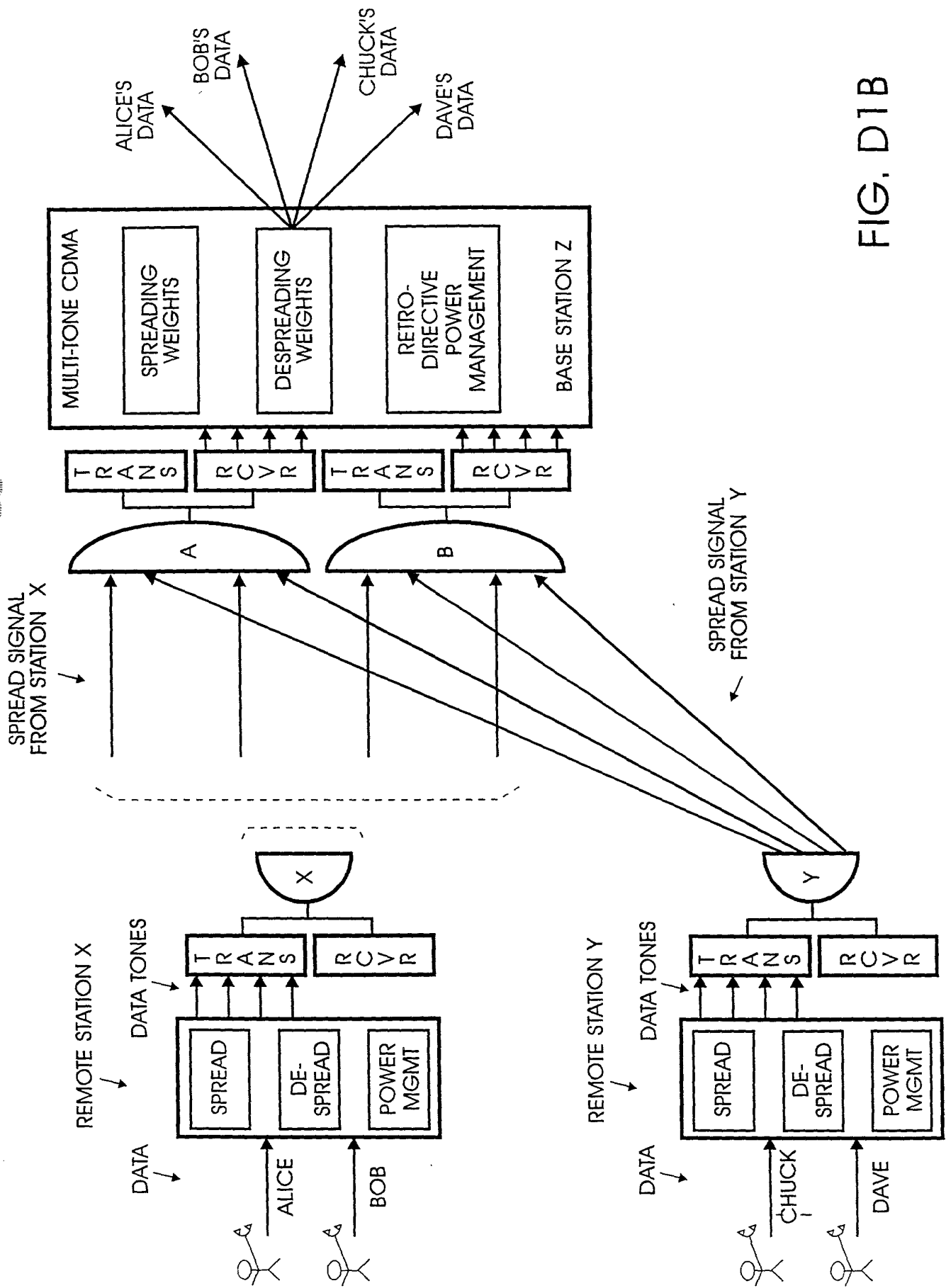


FIG. D1B

FIG. E1A

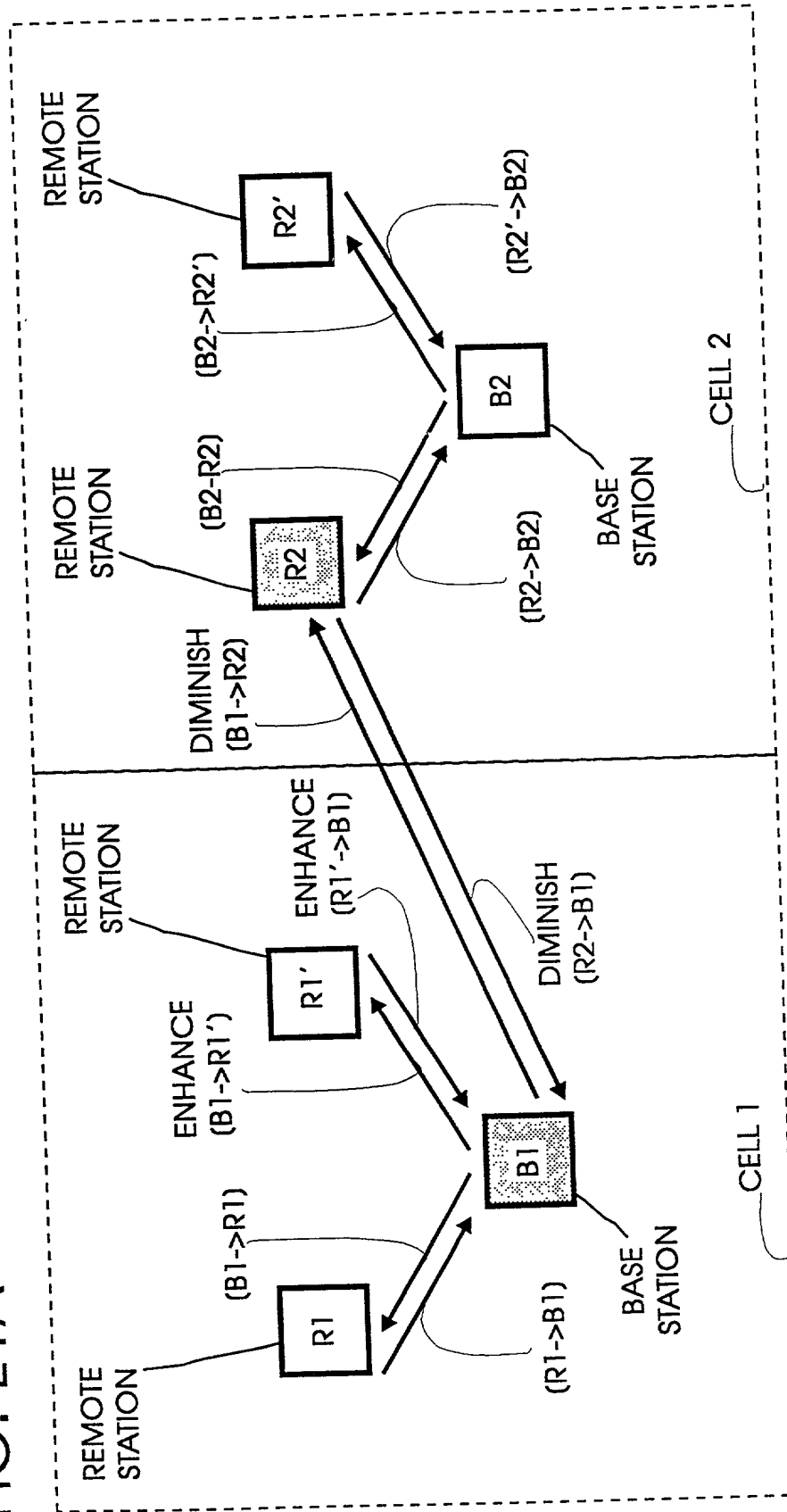


FIG. E1B

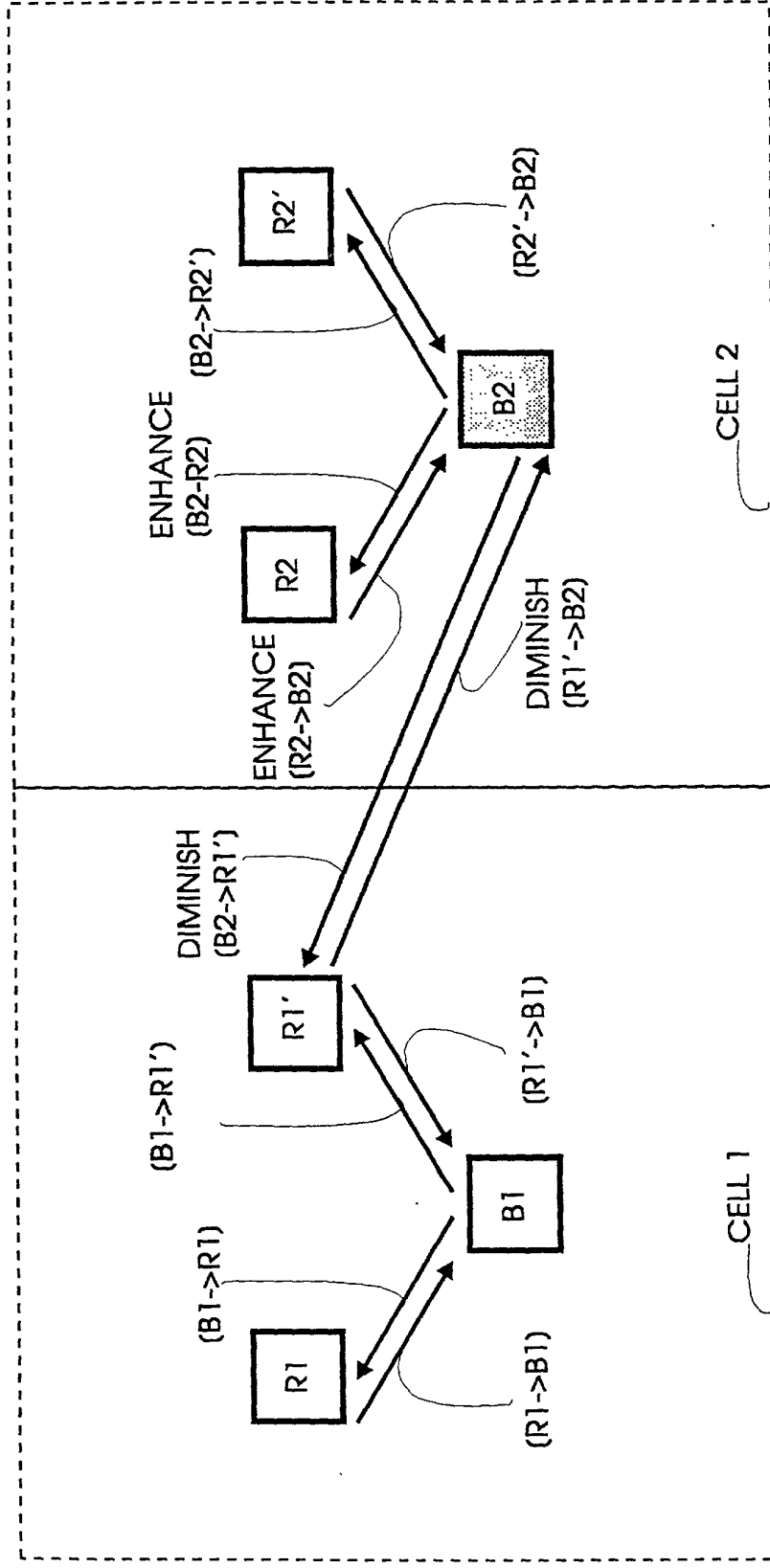


FIG. E1C

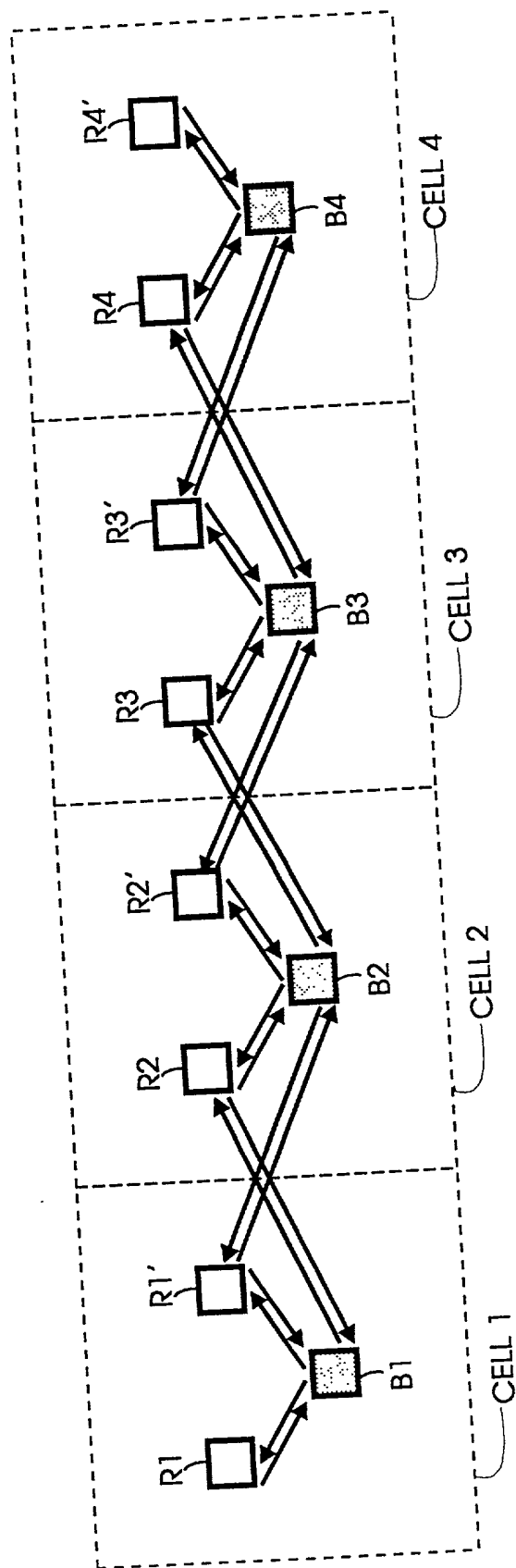


FIG. E2A

FIG. E2A

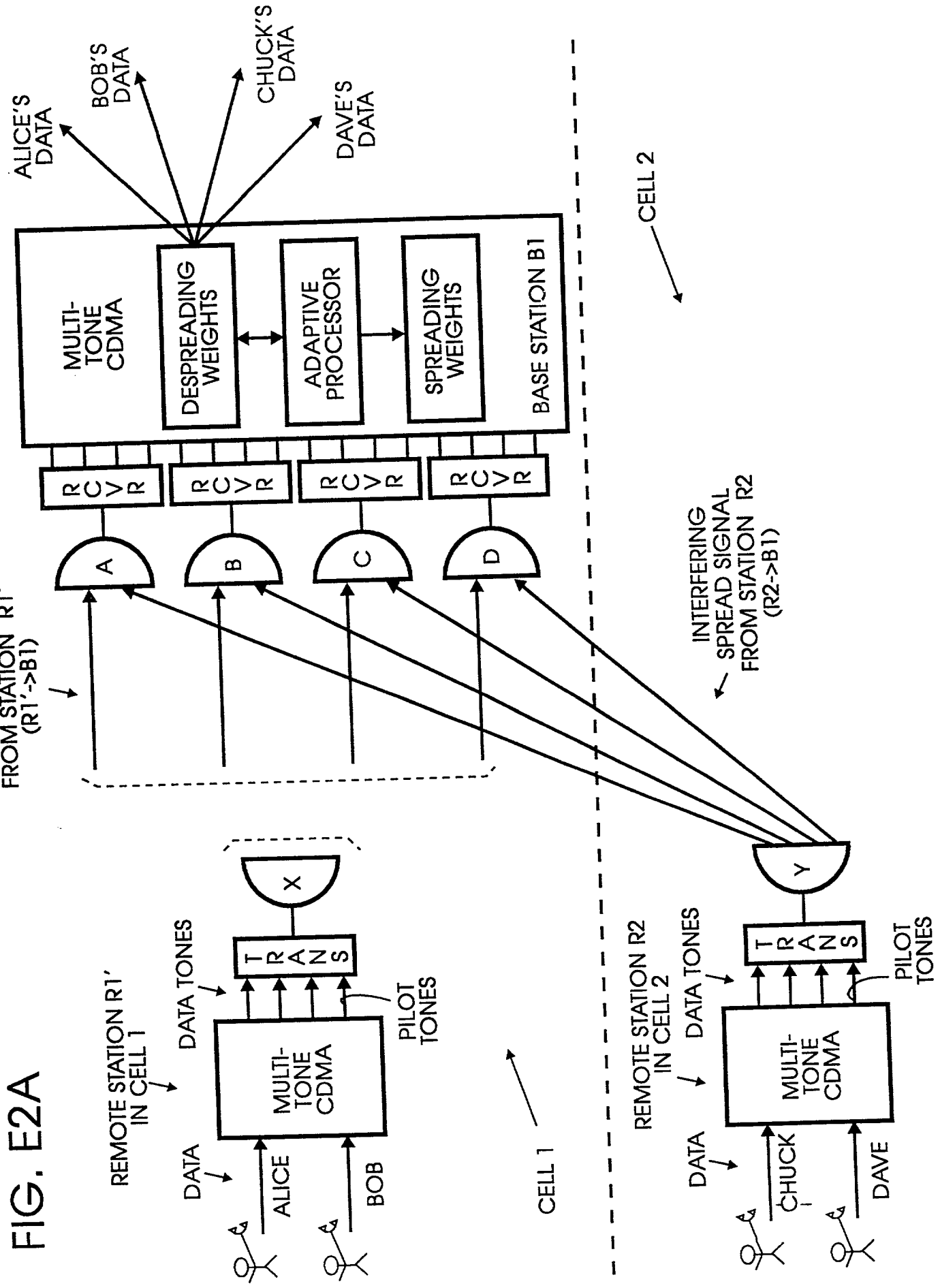


FIG. E2B

